Region 10
United States Environmental Protection Agency

Phase I Fish Tissue Sampling Quality Assurance Project Plan Upper Columbia River Site CERCLA RI/FS

August 31, 2005

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Prepared by

CH2MHILL

ecology and environment, inc.
International Specialists in the Environment

CONTRACT NO 68-S7-04-01

SEA052410003

Title and Approval Sheet

Plan Title:	Phase I Fish Tissue Sampling Quality Assurance Project Plan Upper Columbia River Site CERCLA RI/FS		
Site Name:	Upper Columbia River Site		
Site Location:	North Central Washington State		
City/State/Zip:			
Site USEPA ID# :	WASFN1002171		
Anticipated Sampling Dates:	September—November 2005		
Prepared By:	Frank Dillon and Shaun Roark	Date:	August 2005
Agency or Firm:	CH2M HILL, Inc.		
Address:	1100 112th Ave NE, Suite 400		
City/State/Zip:	Bellevue, WA 98004-4504		
Telephone:	425-453-5000		
USEPA Remedial Project Manager:	Kevin Rochlin	Phone:	(206) 553-2106
	Sally Thomas		(206) 553-2102
QAPP Approval Date:	8/31/05		

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Approved: James Stefanoff, P.E. Date: 8-26-2005
CH2M HILL Project Manager

Approved: Artemis Antipas, Ph.D. Date: 8/29/2005
CH2M HILL Quality Assurance Officer

Approved: Sally Thomas Date: 8/29/05
USEPA Remedial Project Manager

Approved: Ginna Grepo-Grove Date: 8/01/05
USEPA Quality Assurance Officer

Approved: Roy Araki Date: 8/31/05
USEPA Region 10 Quality Assurance Manager

Distribution List

Sally Thomas	USEPA Region 10 Remedial Project Manager
Jim Stefanoff	CH2M HILL Project Manager
Chuck Gruenenfelder	CH2M HILL Task Manager
Frank Dillon	CH2M HILL Field Team Leader
Artemis Antipas	CH2M HILL QA Manager
Ginna Grepo-Grove	USEPA UCR QA Officer/CLP Project Officer
Laura Castrilli	Region 10 Sample Control Coordinator

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[1] *Information in parenthesis indicates the applicable QAPP element or group listed in USEPA (2002a).*

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Acronyms and Abbreviations

ACG	analytical concentration goal
AES	Architect and Engineering Services
BEST	Biomonitoring of Environmental Status and Trends
°C	degree Celsius
CCT	Confederated Tribes of the Colville Reservation (Colville Confederated Tribes)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COI	constituent of interest
CLP	Contract Laboratory Program [USEPA]
cm	centimeter
CV	coefficient of variability
DC	direct current
dioxin	dibenzo-p-dioxin
DOT	U.S. Department of Transportation
DQO	data quality objective
Ecology	Washington State Department of Ecology
ESI	expanded site inspection
Fish Tissue A&R Document	*Phase I Fish Tissue Sampling Approach and Rationale—Upper Columbia River Site CERCLA RI/FS* (CH2M HILL 2005b)
FAR	Federal Acquisition Regulations
FCF	fish collection form
FPF	fish processing form
FSCA	Fish Sampling Collection Area
FSI	Field Safety Instructions
FTL	Field Team Leader
furan	dibenzofuran
GC	gas chromatography
GIS	geographic information system
GPS	global positioning system
HI	hazard index
HQ	hazard quotient
ICS	interference check solution
IDL	instrument detection limit
IRIS	Integrated Risk Information System
MA	modified analysis flexibility clause
LWF	length-weight form
MDL	method detection limit
MEL	Manchester Environmental Laboratory
MRL	method reporting limit
µg/dL	microgram per deciliter
µg/kg	microgram per kilogram

MS/MSD	matrix spike/matrix spike duplicate
NA	not available
N/A	not applicable
NIST	National Institute of Standards and Technology
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCB	polychlorinated biphenyl
PE	performance evaluation
PM	Project Manager
PO	Project Officer
PRG	preliminary remediation goal
PSEP	Puget Sound Estuary Program
PTFE	polytetrafluoroethylene (Teflon)
QA	quality assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
RI/FS	remedial investigation/feasibility study
RL	reporting limit
RM	river mile
RPD	relative percent difference
RSCC	Regional Sample Control Coordinator
RSD	relative standard deviation
RTL	Review Team Leader
SIMS	Site Information Management System
SOP	standard of practice
SOW	statement of work
SPC	Sample Processing Coordinator
SPT	Sample Processing Technician
SRM	standard reference material
STI	Spokane Tribe of Indians
STL	Sampling Team Leader
TAL	Target Analyte List (USEPA)
TBD	to be determined
TOC	total organic carbon
TOPO	Task Order Project Officer
TRV	toxicity reference value
TSU	Technical Support Unit
USCG	U.S. Coast Guard
UCR	Upper Columbia River
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VTSR	validated time of sample receipt
WDFW	Washington Department of Fish and Wildlife
WHO	World Health Organization

SECTION 1

Introduction

SECTION 1

Introduction

This Quality Assurance Project Plan (QAPP) presents the policies, organizations, objectives, and functional activities/procedures for the Phase I fish tissue sampling program being conducted by the U.S. Environmental Protection Agency (USEPA) at the Upper Columbia River (UCR) site in north-central Washington. The QAPP and supporting appendices (Appendix A, Field Safety Instructions; Appendix B, Forms; Appendix C, Standards of Practice [SOPs]; Appendix D, Statistical Assessment Technical Memorandum) have been developed to document the type, quantity, and quality of data needed for environmental decisions and to describe the methods for collecting, generating, and assessing these data during the Phase I fish tissue sampling program.

This QAPP follows USEPA guidelines contained in *EPA Guidance for Quality Assurance Project Plans* (USEPA 1998, 2002a), and *EPA Requirements for Quality Assurance Project Plans* (USEPA 2001). The development, review, approval, and implementation of the QAPP is part of USEPA's mandatory Quality System, which requires all organizations to develop and operate management structures and processes to ensure that data used in agency decisions are of the type and quality needed for their intended use. The following sections of this document are consistent with the subtitles found in the USEPA guidelines (USEPA 2002a).

SECTION 2

Project Management (USEPA Group A)

SECTION 2

Project Management (USEPA Group A)

2.1 Project/Task Organization (A4)

The task order for this project was issued pursuant to USEPA Architect and Engineering Services (AES) Contract No. 68-S7-04-01. The project organization and lines of authority for CH2M HILL staff are illustrated in Figure 2-1, and the fish tissue sampling data flow is shown in Figure 2-2. Figure 2-1 shows both USEPA and CH2M HILL technical personnel and quality assurance personnel. The organizational functions shown are consistent with the overall AES 10 Program Plan (*EPA Management Plans and Standard Operating Procedures For Region 10 Architect Engineering Services*, Contract Solicitation No. PR-R7-02-10217 [CH2M HILL 2003]). The AES 10 Program Plan provides additional details for these organizational functions.

2.1.1 Program Management

The task order is managed by CH2M HILL's Project Manager (PM), who works directly with the USEPA Remedial Project Manager (referred to herein as Task Order Project Officer [TOPO]) to accomplish the task order. Jim Stefanoff serves as the CH2M HILL PM. The PM manages the financial, schedule, and technical aspects of the task order. The key people involved in interfacing with the PM are the TOPO, Quality Assurance Officer (QAO), Review Team Leader (RTL), and Sampling Team Leader (STL).

USEPA has two TOPOs for the overall UCR project. Sally Thomas is the TOPO who is responsible for fish sampling. Kevin Rochlin is the TOPO who was responsible for the sediment sampling.

Gina Grepo-Grove acts as the USEPA QAO. The QAO works with the review team (led by the RTL) to review project planning documents, data evaluation, and deliverables. The primary responsibility for project quality rests with the PM, and independent quality control is provided by the RTL and QAO. Where quality assurance problems or deficiencies requiring special action are uncovered, the PM, RTL, and QAO will identify the appropriate corrective action to be initiated by the STL or the laboratory.

Dave Bunte acts as the CH2M HILL RTL. The RTL works with the PM and the QAO to assure the quality of all planning documents, data evaluation, and deliverables.

Laura Castrilli acts as the USEPA Regional Sample Control Coordinator (RSCC). The RSCC is responsible for both Contract Laboratory Program (CLP) and USEPA Manchester Environmental Laboratory (MEL) coordination. The RSCC works with the QAO, the region's CLP Project Officer (PO), and USEPA's TOPOs in resolving laboratory and field quality assurance (QA) issues and laboratory scheduling. The RSCC provides the regional sample tracking numbers, sample tags, custody seals, and other CLP-required chain-of-custody documentation. The RSCC and CLP PO also prepare the modified analysis

flexibility clauses (MAs) to the existing CLP statements of work (SOWs) in order to meet the specific project needs and data quality objectives (DQOs).

The subcontract administrator is responsible for procuring subcontracts for USEPA's AES projects under Federal Acquisition Regulations (FAR) and provides the interface with subcontractors. Subcontractors may be used on this task order for laboratory analyses depending on USEPA Regional Laboratory availability.

The sampling team will implement the QAPP and Field Safety Instructions (FSI). The safety coordinator is responsible for adherence to the FSI and field decontamination procedures. The entire field effort is directed by the STL.

2.1.2 Sampling Team Roles and Responsibilities

The field sampling team organization for the Phase I fish sampling is shown in Figure 2-3. The sampling team will consist of CH2M HILL staff as well as staff of various tribal and federal agencies.

Frank Dillon will act as the CH2M HILL STL. The STL will have day-to-day working knowledge of all aspects of establishing and maintaining the onsite field operations, including staffing and on-the-scene decision-making. The STL will work directly with the CH2M HILL Field Team Leaders (FTLs) to coordinate the actual fish collection activities and with the CH2M HILL Sample Processing Coordinator (SPC) on sample processing, documentation, and sample handling. Both the STL and the SPC will communicate daily with the FTLs on the progress of the sampling effort. The STL will work with the FTLs and the SPC on any modifications to sampling and handling that are required due to site conditions. If it is necessary to modify the sampling for contingencies (see Section 3.1.6), the STL will contact the PM, TOPO, and QAO prior to making the modifications.

The sampling will be completed by several field sampling teams and an onshore sample processing crew. A sampling team will consist of an FTL, a vessel operator, and a sample technician. Throughout the course of the sampling effort, it is anticipated that five different sampling teams will be used. In all cases the boat, vessel operator, and sample technician will be provided by a cooperating tribal or federal agency. See Figure 2-3 for anticipated sampling crews.

All sample crews will be led by an FTL from the CH2M HILL team. The FTLs will direct daily field operations, act as the onsite safety coordinator for each team, and coordinate closely with the STL and vessel operators concerning operational procedures.

Sample vessels and vessel operators will be provided by the following tribal and federal agencies:

- Spokane Tribe of Indians (STI)—Subcontracted to CH2M HILL
- Confederated Tribes of the Colville Reservation (Colville Confederated Tribes [CCT])—Interagency agreement with USEPA
- U.S. Fish and Wildlife Service (USFWS)—Interagency agreement with USEPA
- USEPA—Internal

Figure 2-3 provides information for the point of contact from each tribal and federal agency involved in the sampling. The tribal or federal agency point of contact will be responsible for coordinating with the STL on the availability and performance of the sample vessels, vessel operators, and sample technicians.

The vessel operators are responsible at all times for the prudent and safe operation of the vessel and are responsible for approving or disapproving any particular operation or maneuvering of the vessel. The vessel operators will be trained biologists with experience navigating and sampling the UCR or similar environments. The STL will have final decision authority on any modifications to the study design warranted by operating considerations. Sample technicians will provide by each tribal and federal agency as needed to support the FTL.

The onshore sample processing crew will consist of the SPC and one or two CH2M HILL Sample Processing Technicians (SPTs). Nahide Gulensoy will act as the CH2M HILL SPC. The SPC will direct all sample processing, shipping, and logistics in the field and will serve as the main point of contact with RSCC. The SPTs will perform all aspects of sample processing, shipment, and transport. The onshore processing steps that require external examination of fish will be performed by an FTL or a trained fisheries biologist.

2.2 Problem Definition/Background (A5)

2.2.1 Purpose

This QAPP presents the policies, organizations, objectives, and functional activities/procedures for the Phase I fish tissue sampling program being conducted by USEPA at the UCR site in north-central Washington. The QAPP was developed to document the type, quantity, and quality of data needed for environmental decisions and to describe the methods for collecting, generating, and assessing those data during the Phase I fish tissue sampling program. The samples will be analyzed during the RI, and the data obtained will be used to characterize the nature and extent of contamination in this medium at the site, perform human health and ecological risk assessments, and evaluate potential remedies that are protective of human and ecological receptors.

2.2.2 Problem Statement

In August 1999, CCT petitioned USEPA to conduct an assessment of hazardous substance contamination at the UCR. The petition expressed concerns about possible risks to people's health and the environment from contamination in the river. In December 2000, USEPA completed a preliminary assessment (USEPA 2000a). Based on a review of available information and existing data, USEPA determined that further data collection was warranted.

In 2001, USEPA conducted an expanded site inspection (ESI) at the UCR and collected sediment samples to assess contaminant concentrations in river sediment and to determine whether further detailed investigation such as a remedial investigation/feasibility study (RI/FS) was warranted (USEPA 2003). The results of the investigation showed that widespread contamination is present in the lake and river sediment and that an RI/FS was

necessary to evaluate possible risks to human health and the environment. The RI/FS is to include the sampling and analysis of both sediment and fish.

Sediment sampling was conducted in April 2005. The sampling is described in detail in the USEPA-approved sediment QAPP (CH2M HILL 2005c). A total of 363 sediment samples were collected. A variety of analyses were conducted, including Target Analyte List (TAL) metals (plus uranium), TAL semivolatile organic compounds (SVOCs), TAL pesticides, polychlorinated biphenyls (PCB) Aroclors, dibenzo-p-dioxins (dioxins), dibenzofurans (furans), particle size, and total organic carbon (TOC). Laboratory toxicity tests were also conducted. Chemical analysis was conducted by a CLP laboratory. Sediment toxicity tests were conducted by Northwest Aquatic Sciences and Applied Life Sciences laboratories.

This document addresses the study of fish for the RI/FS.

2.2.3 Background

The UCR site is located in north-central Washington and extends from the U.S.-Canadian international border south and west to Grand Coulee Dam, a distance of approximately 147 miles downriver. The UCR site includes a riverine reach of the Columbia River as well as Franklin D. Roosevelt Lake (Lake Roosevelt), a large reservoir behind Grand Coulee Dam. The transition between the riverine reach and Lake Roosevelt occurs approximately 15 miles south of the United States-Canadian border and 132 miles upriver from Grand Coulee Dam when the reservoir is full.

Previous investigations by federal and state agencies have identified the presence of contamination within the U.S. portion of the UCR and surrounding upland areas from Grand Coulee Dam to the Canadian border (U.S. Geological Survey [USGS] 1994 and 2000, Washington State Department of Ecology [Ecology] 1989, 1991, and 1994). Other studies have evaluated contaminant source areas and effects north of the Canadian border (Ministry of Environment, Lands, and Parks, Province of British Columbia 1992, Teck Cominco 2001). Potential sources of contamination include mining and milling operations, smelting operations, pulp and paper production, sewage treatment plants, and other industrial activities. Contaminants found by the studies are documented in *Phase I Fish Tissue Sampling Approach and Rationale—Upper Columbia River Site CERCLA RI/FS* (Fish Tissue A&R Document) (CH2M HILL 2005b) and include heavy metals such as cadmium, copper, lead, mercury, and zinc, as well as organic contaminants such as polychlorinated dioxins, polychlorinated furans, and PCBs.

2.3 Project/Task Description (A6)

2.3.1 Description of Work to be Performed

Activities to be performed as part of the Phase I fish tissue sampling are as follows:

- Collect five species of fish at six sample areas distributed over the length of the study area, with the following objectives:
  - Provide data that are representative of the UCR study area

  - Provide data that represent expected exposure areas for the target fish species (that is, within their typical home range)
  - Provide data that are representative of areas where recreational and tribal anglers harvest and consume Lake Roosevelt fish
  - Provide data that are representative of areas where wildlife may forage for Lake Roosevelt fish
  - Provide overlapping areas with the sediment sampling focus areas for comparison to sediment contaminant data
  - Provide data that can be used to estimate human health and ecological risk from exposure to contaminants in fish
- At each sample location, prepare composite samples (five fish) of each species that are representative of the fish consumed by human and wildlife receptors
- Analyze each composite sample for the following:
  - TAL metals
  - Inorganic arsenic (20 percent of samples)
  - Polychlorinated biphenyl (PCB) Aroclors
  - PCB congeners
  - Dioxin/furan congeners
  - Percent lipids
  - Percent moisture
- Conduct data evaluation, including risk assessment
- Prepare reports

Additional details on the objectives and rationale for the fish tissue sampling program are provided in the Fish Tissue A&R Document (CH2M HILL 2005b) and in Section 2.4, below.

2.3.2 Schedule of Activities

A preliminary schedule of activities for the UCR project is provided in Table 2-1. The purpose of the preliminary schedule is to facilitate scheduling with USEPA and analytical laboratories. The final schedule may differ if fish collection or tissue homogenization takes more or less time than anticipated. Field mobilization for the work described in this QAPP began in August 2005. The sampling and subsequent analytical work are expected to be initiated in September 2005 and conclude by the end of March 2006. A detailed field operations schedule is presented in Section 3.2.1.1.

2.4 Quality Objectives and Criteria (A7)

2.4.1 Project Quality Objectives

Project-specific DQOs were identified through the DQO process/planning tool (USEPA 1994a, 2000b). The overall objective of the RI/FS for the UCR site is to identify site contamination, assess potential risk to human or ecological receptors, and develop remedial approaches to mitigate unacceptable risk. Meeting the objective for contaminants found in fish tissue at the UCR site requires an understanding of the following components of the conceptual site model so that appropriate remedial actions can be assessed:

- Contaminant sources
- Nature and extent of contaminants in fish
- Patterns of fish use representative of recreational anglers and tribal consumers following traditional subsistence lifeways
- Ecological receptors and exposure pathways for contaminated fish tissue

The primary purpose of the Phase I fish tissue sampling program is to gather data to support (1) the human and ecological risk assessments, and (2) analyses to consider issuance of an updated fish advisory for Lake Roosevelt. The Phase I fish tissue sampling program may also provide information to support other components of the conceptual site model. Following are secondary study objectives:

- Characterize the spatial patterns of contaminants
- Establish baseline contaminant levels for comparison with future surveys
- Correlate tissue concentrations with contaminant concentrations in sediment
- Compare contaminant levels among fish species
- Compare contaminant levels among river reaches
- Characterize the variation in contaminant concentrations among individual fish of a species

2.4.1.1 Data Quality Objectives Process

The Data Quality Objectives Process of USEPA was used to identify specific needs for the project and to establish decision rules for the collection of fish tissue data to support RI/FS tasks and activities. The DQO process is a seven-step iterative planning approach used to prepare plans for environmental data collection activities and is intended to help site managers plan to collect data of the right type, quality, and quantity to support defensible site decisions. The seven steps are as follows:

1. State the Problem—Summarize the contamination problem that will require new environmental data, and identify the resources available to resolve the problem; develop conceptual site model.

2. Identify the Decision—Identify the decision that requires new environmental data to address the contamination problem.

3. Identify Inputs to the Decision—Identify the information needed to support the decision and specify which inputs require new environmental measurements.

4. Define the Study Boundaries—Specify the spatial and temporal aspects of the environmental media that the data must represent to support the decision.

5. Develop a Decision Rule—Develop a logical "if. . . then. . ." statement that defines the conditions that would cause the decision-maker to choose among alternative actions.

6. Specify Limits on Decision Errors—Specify the decision-maker's acceptable limits on decision errors, which are used to establish performance goals for limiting uncertainty in the data.

7. Optimize the Design for Obtaining Data—Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs.

2.4.1.2 Phase I Fish Tissue Data Quality Objectives

This section details the fish tissue DQOs as they relate to the Phase I fish tissue sampling program. The following pages list the DQOs in the format presented in USEPA (2000b).

The overall sampling program for Phase I is summarized in Table 2-2. Risk-based analytical concentration goals (ACGs) are provided in Table 2-3. This table lists the specific analytes, potential ecological and human health risk goals, and ACGs, with the ACG being the lowest potential risk criterion for the given analyte. Use of these criteria at this time does not imply that these will be the screening level toxicity reference values used in the risk assessments. Their primary use is to help set analytical detection limits. The ACGs shown in Table 2-3 were taken into consideration during selection of appropriate analytical methodologies. The selected analytical methodologies and associated laboratory analytical quantitation limits are listed in Table 2-4.

For fish analyses, the analytical/laboratory reporting limits are matrix and laboratory specific. The laboratories will target the needed levels shown in Table 2-3 and will report detection levels on a sample/analyte-specific basis. The selected methods are state of the art and what is practicable for this study. For reporting limits that are above the levels in Table 2-3, the project team may use the laboratory-specific method detection limits (MDLs), which are expected to be significantly lower than the reporting levels, as further discussed in Section 2.4.2.

Human Health Risk Assessment DQOs

Step 1. State the Problem—Human Health Risk Assessment

(1)	Identify members of the planning team	Kevin Rochlin and Sally Thomas—USEPA TOPOs Burt Shephard, Marc Stifelman—USEPA Risk Assessors Jim Stefanoff—CH2M HILL Project Manager Chuck Gruenenfelder—CH2M HILL RI Task Leader Dennis Shelton—CH2M HILL Risk Assessment Task Leader Frank Dillon—CH2M HILL Lead Biologist Artemis Antipas—CH2M HILL Quality Assurance Officer/Chemist John Skalski—Statistical Assessment Consultant
(2)	Identify the primary decision-maker	Decisions will be made by consensus among USEPA managers and risk assessment task leaders.
(3)	Develop a concise description of the problem	Contaminants are likely present in edible fish at concentrations that pose unacceptable risk to some people who consume fish from the UCR.
(4)	Specify available resources and relevant deadlines for the study	Historical fish tissue data are not of adequate quality or coverage to assess current potential risk. Phase I sampling is scheduled for September to November 2005. Project resources are described in Section 3. The need for, and schedule of, additional fish tissue sampling events will be determined following evaluation of Phase I data.

Step 2. Identify the Decision—Human Health Risk Assessment

(1)	Identify the principal study question	Determine whether measures are needed to reduce fish contaminant concentrations, and/or reduce exposure to people consuming fish from the UCR depending on the levels of contamination and the intensity of consumption.
(2)	Define alternative actions that could result from resolution of the principal study question	(a) No action. (b) Additional data are needed. (c) Remedial action alternatives are developed.
(3)	Combine the principal study question and the alternative actions into a decision statement	Compare human health risk (excess cancer risk) and hazard index (HI) (adverse noncancer effects) estimates with regulatory risk targets, and determine the appropriate actions, which may include: • No action, or revision to the current fish advisories in effect for Lake Roosevelt • Additional data collection • Development of remedial action to address fish contamination based on human health measures of cancer and noncancer risk

(4)	Organize multiple decisions	If calculated cancer risk and HI estimates are below regulatory risk targets, with low uncertainty, then no further action may be taken. If calculated cancer risk and HI estimates are below regulatory risk targets, with moderate to high uncertainty, then additional data collection may be necessary. If calculated cancer risk and HI estimates are above regulatory risk targets, with moderate to high uncertainty, then additional data collection may be necessary. If calculated cancer risk and HI estimates are above regulatory risk targets, with low uncertainty, then remedial action alternatives will need to be developed.

Step 3. Identify Inputs to the Decision—Human Health Risk Assessment

(1)	Identify information that will be required to resolve the decision statement	Conceptual exposure model, including receptor populations, exposure patterns, exposure pathways, and ingestion rates. Risk-based action levels (human health cancer risk and HI estimates) for each exposure pathway and exposure area. Measured contaminant levels in edible fish tissue (size- and age-specific information for whole fish and fillets).
(2)	Determine the sources for each item of information required	Demographic information. Fish consumption information (intake rates and body parts). USEPA Integrated Risk Information System (IRIS) and other toxicological databases and literature values. Chemical analysis of Phase I fish tissue samples (analytes listed in Table 2-3. Length, weight, and age of each fish analyzed.
(3)	Identify the information that is needed to establish the action level	Cancer risk, HI, and ecological benchmark estimates for each exposure scenario.
(4)	Confirm the appropriate measurement methods exist to provide the necessary data	Methods consistent with the above needs are identified in Section 3.

Step 4. Define the Boundaries for the Study—Human Health Risk Assessment

(1)	Specify the characteristics that define the population of interest	Selected fish species (Table 2-2) that inhabit the UCR of a size range normally consumed by the general population and tribal members, fish, and other wildlife. Potential contaminants include metals, PCBs, and dioxins/furans (specific metals and congeners are listed in Table 2-2).
(2)	Define the spatial boundary of the decision statement	Decisions will be made using a variety of spatial boundaries as determined by the conceptual exposure model and the patterns of contaminant concentrations in fish tissue from the Columbia River between the U.S.-Canadian Border and Grand Coulee Dam).
(3)	Define the temporal boundary of the decision statement	Phase I sampling will be completed in November 2005; decisions regarding risk or need for additional data are anticipated to be made within 2 years after Phase I data are received.

(4)	Define the scale of decision-making	The scale of the decision will be made based on the conceptual exposure model and the patterns of contaminant concentrations in fish tissue across the site. The smallest decision-making unit may include approximately one-third of the study area.
(5)	Identify practical constraints on data collection	Data collection and analysis may be constrained by limitations in funds currently obligated for this study. In addition, holding times for some contaminants, including mercury, may be exceeded depending on available funds and laboratory capacity. The exposure units may range in size from individual sample reaches (e.g., upper, middle, or lower) to the entire UCR site. The distribution of fish is not homogeneous throughout the study area. Therefore, collection of statistically optimal numbers of target fish species and size ranges in all collection areas may not be feasible. Sampling contingencies are discussed in Section 3.1.6.

Step 5. Develop a Decision Rule—Human Health Risk Assessment

(1)	Specify the statistical parameter that characterizes the population of interest	The study will analyze composite samples of five individual fish fillets or offal. Depending on availability of fish, a minimum of three individuals may be used. Composites will be randomly assigned for a specified species and location to allow estimates of variability among individual fish. Variance estimates will be used to make inferences about the target population at various levels of confidence, or sample maximums may be used. Inferences may be extended to species not collected based on similar feeding patterns or ecological niche. Results will be presented by species, tissue type, and location.
(2)	Specify the action level for the study	Specific action levels have not yet been determined, but will be established in consultation with federal, tribal, state, and local stakeholders. The CERCLA cancer risk range ($1x10^{-6}$ to $1x10^{-4}$) and a target hazard quotient (HQ) of 1.0 will be considered as preliminary action levels.
(3)	Develop a decision rule (an "if...then..." statement	If calculated cancer risk or HI estimates are above regulatory risk targets and uncertainties are acceptable, a remedial action alternative may need to be developed; otherwise, no further evaluation is necessary for human health reasons.

Step 6. Specify Tolerable Limits on Decision Errors—Human Health Risk Assessment

(1)	Determine the range of the parameters of interest	Analytical results for historical fish tissue samples have been reviewed and compiled in a database from which the potential ranges of certain contaminant concentrations have been derived. However, the expected range may differ from historical results because of differences in sample locations, collection dates, and types of tissue analyzed.

(2)	Identify the decision errors and choose a null hypothesis	Decision errors and precision were analyzed in terms of relative percent differences between sample means. Decision errors were estimated for a range of relative differences in concentrations over a range of alpha (α), coefficient of variability (CV), and sample size (n) in Figures 1 and 2 of a statistical assessment technical memorandum prepared for the fish tissue sampling program (Skalski 2005; provided in Appendix D of this QAPP). The relative error will decrease with smaller estimates of CV and larger sample sizes. Because different types of fish samples are distributed throughout the study area, the probability of decision errors will increase with the specificity of the analysis (i.e., decision errors will be higher for inferences related to a specific reach versus the entire study area). For example, in Figure 2, if the CV is 0.55 and α is 0.05), the power to detect a 50 percent difference in concentrations is 90 percent for an n of 10 samples (the number of rainbow trout for each of the three reaches) and approaches 100 percent for n of 30 (the total number of rainbow trout collected in all three river reaches The precision, accuracy, representativeness, comparability, and completeness (PARCC) criteria listed in this QAPP and the minimum detection limits listed in Tables 2-4 and 2-5 will be used to evaluate the usability of analytical data in making decisions about potential risk. Analyte-specific accuracy and precision ranges are shown in Table 2-5. The project completeness target is set at 90 percent. Because the error for precision and accuracy is on average about 30 percent, the consequences of decision errors based on sample results less than half the specified detection levels or greater than twice the specified detection levels are expected to be relatively small.
(3)	Specify a range of possible values of the parameter of interest where the consequences of decision error are relatively minor	Based on resource constraints relative to the large study area, as well as uncertainties in exposure and toxicity data used to describe risk, the ability to estimate tissue concentrations with a relative area error of 50 percent is considered acceptable or minor.
(4)	Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors.	The methods and probability values to be used in evaluating decision errors relative to action levels are described in Appendix D, Statistical Assessment Technical Memorandum (see Figures 1 and 2 for precision and power estimates).

Step 7. Optimize the Design—Human Health Risk Assessment

(1)	Review the DQO outputs and existing data	See Steps 1 to 6.
(2)	Develop general data collection design alternatives	The rationale for the sampling design is described in the Fish Tissue A&R Document (CH2M HILL 2005b). The sampling program is summarized in Table 2-2.
(3)	Formulate the mathematical expressions necessary for each design alternative	The methods to be used in aggregating data and evaluating results for the risk assessment are described in Appendix D.
(4)	For each data collection design alternative, select the optimal sample size that satisfies the DQOs	The sampling approach and sample sizes are described in Table 2-2.

(5)	Select the most resource-effective data collection design that satisfies the DQOs	The rationale for the sampling design is described in the Fish Tissue A&R Document (CH2M HILL 2005b). This design includes (a) sampling five species of fish known to be consumed by humans, (b) analyzing samples as both whole fish and fillets, and (c) composite sampling to allow for a broader representation of the average exposure area for the target species. The sampling program is summarized in Table 2-2. Target analytes are listed in Table 2-3. The following specific steps will be taken to minimize analytical costs while providing the necessary data: 1. A composite sample approach will be used for all fish species at all sites in this study (USEPA 2000c). The target number of fish per composite will be five individuals, the target number of composite samples per collection area will be five, and the target number of collection areas will be six. 2. Inorganic arsenic analysis will be performed on 20 percent of samples. Similar arsenic speciation will be inferred for the remaining samples. 3. PCB congener analysis will be performed for as many congeners as practical by the analytical laboratory on 20 percent of the samples. The 20 percent will be composed of one of the five composite samples for each species at each Fish Sampling Collection Area (FSCA). The remaining samples will be analyzed for the dioxin-like congeners on the World Health Organization (WHO) list and an additional select group of congeners that are most common in the first group of samples. Final decisions on the number of additional congeners to be analyzed will be made after review of the first set of analyses.
(6)	Document the operational details and theoretical assumptions of the selected design in the sampling and analysis plan	Section 3 provides the operational details and assumptions for the fish tissue sampling design.

Aquatic Risk Assessment DQOs

Step 1. State the Problem—Aquatic Risk Assessment

(1)	Identify members of the planning team	Kevin Rochlin and Sally Thomas—USEPA TOPOs Burt Shephard, Marc Stifelman—USEPA Risk Assessors Jim Stefanoff—CH2M HILL Project Manager Chuck Gruenenfelder—CH2M HILL RI Task Leader Dennis Shelton—CH2M HILL Risk Assessment Task Leader Frank Dillon— CH2M HILL Lead Biologist Artemis Antipas—CH2M HILL Quality Assurance Officer/Chemist John Skalski—Statistical Assessment Consultant
(2)	Identify the primary decision-maker	Decisions will be made by consensus among USEPA managers and risk assessment task leaders.
(3)	Develop a concise description of the problem	Contaminants may be present in fish tissue at concentrations that pose unacceptable risk to fish themselves in the UCR site.
(4)	Specify available resources and relevant deadlines for the study	Historical fish tissue data are not of adequate quality or coverage to assess potential risk. Phase I sampling is scheduled for September to November 2005. Project resources are described in Section 3. The need for, and schedule of, additional fish tissue sampling events will be determined following evaluation of Phase I data.

Step 2. Identify the Decision—Aquatic Risk Assessment

(1)	Identify the principal study question	Determine whether measures are needed to prevent exposure of fish or bioaccumulation of site contaminants from the UCR to contaminant concentrations that pose unacceptable risk to fish.
(2)	Define alternative actions that could result from resolution of the principal study question	(a) No action. (b) Additional data are needed. (c) Remedial action alternatives are developed.
(3)	Combine the principal study question and the alternative actions into a decision statement	Compare representative constituent of interest (COI) concentrations in fish to risk-based concentrations protective of fish and determine the appropriate action: no action, additional data collection, or remedial action development.
(4)	Organize multiple decisions	If the weight of evidence indicates that fish are not potentially at risk, with low uncertainty, then no further action may be taken. If the weight of evidence indicates that fish are not potentially at risk, with moderate to high uncertainty, then additional data collection may be necessary. If the weight of evidence indicates that fish are potentially at risk, with moderate to high uncertainty, then additional data collection may be necessary. If the weight of evidence indicates that fish are potentially at risk, with low uncertainty, then remedial action alternatives will need to be developed.

Step 3. Identify Inputs to the Decision—Aquatic Risk Assessment

(1)	Identify information that will be required to resolve the decision statement	Defined conceptual exposure model. The conceptual exposure model must demonstrate complete exposure pathways from environmental sources of contaminants (water, sediment, diet) to the targeted fish species. Fish tissue residue effects levels (literature-based). A toxicity reference value (TRV) for concentrations of COIs in fish tissue is also necessary to establish the action level. Available indicators of fish health. Measured contaminant levels in fish tissue (e.g., whole body).
(2)	Determine the sources for each item of information required	Toxicological databases and literature. Chemical analysis of Phase I fish tissue samples (analytes listed in Table 2-3).
(3)	Identify the information that is needed to establish the action level	HQ estimates for each contaminant. Length, weight, and age of each fish analyzed.
(4)	Confirm the appropriate measurement methods exist to provide the necessary data	Methods consistent with the above needs are identified in Section 3.

Step 4. Define the Boundaries for the Study—Aquatic Risk Assessment

(1)	Specify the characteristics that define the population of interest	Selected fish species (Table 2-2) that inhabit the UCR. Potential contaminants include metals, PCBs, and dioxins/furans (specific metals and congeners are listed in Table 2-3).
(2)	Define the spatial boundary of the decision statement	Decisions will be made using a variety of spatial boundaries as determined by the conceptual exposure model and the pattern of contaminant concentrations in fish tissue across the site (note that the Phase I study area is bounded by the U.S.-Canadian Border and Grand Coulee Dam).
(3)	Define the temporal boundary of the decision statement	Phase I sampling will be completed in November 2005; decisions regarding risk or need for additional data are anticipated to be made within 2 years after Phase I data are received.
(4)	Define the scale of decision-making	The scale of the decision will be made based on the conceptual exposure model and the pattern of contaminant concentrations in fish tissue across the site. The smallest decision-making unit may include approximately one-third of the study area.
(5)	Identify practical constraints on data collection	Data collection and analysis may be constrained by limitations in funds currently obligated for this study. In addition, holding times for some contaminants, including mercury, may be exceeded depending on available funds and laboratory capacity The exposure units may range in size from individual reaches (e.g., upper, middle, and lower) to the entire UCR site. The distribution of fish is not homogeneous throughout the study area. Therefore, collection of statistically optimal numbers of target fish species and size ranges in all collection areas may not be feasible. Sampling contingencies are discussed in Section 3.1.6.

Step 5. Develop a Decision Rule—Aquatic Risk Assessment

(1)	Specify the statistical parameter that characterizes the population of interest	The study will analyze composite samples of five individual fish fillets or offal. Depending on availability of fish, a minimum of 3 individuals may be used. Composites will be randomly assigned for a specified species and location to allow estimates of variability among individual fish. Variance estimates will be used to make inferences about the target population at various levels of confidence, or sample maximums may be used. Inferences may be extended to species not collected based on similar feeding pattern or ecological niche. Results will be presented by species, tissue type, and location.
(2)	Specify the action level for the study	General and, if possible, receptor-specific protective concentrations will be developed for use in the aquatic risk assessment.
(3)	Develop a decision rule (an "if...then..." statement	If representative COI concentrations are above protective concentrations, a remedial action alternative may need to be developed; otherwise, no further evaluation is necessary for aquatic risk reasons.

Step 6. Specify Tolerable Limits on Decision Errors— Aquatic Risk Assessment

(1)	Determine the range of the parameters of interest	Analytical results for historical fish tissue samples have been reviewed and compiled in a database from which the potential ranges of certain contaminant concentrations have been derived. However, the expected range may differ from historical results because of differences in sample locations, collection dates, and types of tissue analyzed.
(2)	Identify the decision errors and choose a null hypothesis	Decision errors and precision were analyzed in terms of relative percent differences between sample means. Decision errors were estimated for a range of relative differences in concentrations over a range of alpha (α), coefficient of variability (CV), and sample size (n) in Figures 1 and 2 of a statistical assessment technical memorandum prepared for the fish tissue sampling program (Skalski 2005; provided in Appendix D of this QAPP). The relative error will decrease with smaller estimates of CV and larger sample sizes. Because different types of fish samples are distributed throughout the study area, the probability of decision errors will increase with the specificity of the analysis (i.e., decision errors will be higher for inferences related to a specific reach versus the entire study area). For example, in Figure 2, if the CV is 0.55 and α is 0.05), the power to detect a 50 percent difference in concentrations is 90 percent for an n of 10 samples (the number of rainbow trout for each of the three reaches) and approaches 100 percent for n of 30 (the total number of rainbow trout collected in all three river reaches The PARCC criteria listed in this QAPP and the minimum detection limits listed in Tables 2-4 and 2-5 will be used to evaluate the usability of analytical data in making decisions about potential risk. Analyte-specific accuracy and precision ranges are shown in Table 2-5. The project completeness target is set at 90 percent. Because the error for precision and accuracy is on average about 30 percent, the consequences of decision errors based on sample results less than half the specified detection levels or greater than twice the specified detection levels are expected to be relatively small.

(3)	Specify a range of possible values of the parameter of interest where the consequences of decision error are relatively minor	Based on resource constraints relative to the large study area, as well as uncertainties in exposure and toxicity data used to describe risk, the ability to estimate tissue concentrations with a relative area error of 50 percent is considered acceptable or minor.
(4)	Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors.	The methods and probability values to be used in evaluating decision errors relative to action levels will be described in a Statistics Assessment Technical Memorandum.

Step 7. Optimize the Design—Aquatic Risk Assessment

(1)	Review the DQO outputs and existing data	See Steps 1 to 6.
(2)	Develop general data collection design alternatives	The rationale for the sampling design is described in the Fish Tissue A&R Document (CH2M HILL 2005b). The sampling program is summarized in Table 2-2.
(3)	Formulate the mathematical expressions necessary for each design alternative	The methods to be used in aggregating data and evaluating results for the aquatic risk assessment are described in the Statistics Assessment Technical Memorandum (Appendix D).
(4)	For each data collection design alternative, select the optimal sample size that satisfies the DQOs	The sampling approach and sample sizes are described in Table 2-2.
(5)	Select the most resource-effective data collection design that satisfies the DQOs	The rationale for the sampling design is described in the Fish Tissue A&R Document (CH2M HILL 2005b). This design includes (a) sampling five species of fish that represent major feeding guilds within the fish community, (b) analyzing samples as whole fish, and (c) composite sampling to allow for a broader representation of the average exposure area for the target species. The sampling program is summarized in Table 2-2. Target analytes are listed in Table 2-3. The following specific steps will be take to minimize analytical costs while providing the necessary data: 1. A composite sample approach will be used for all fish species at all sites in this study (USEPA 2000c). The target number fish per composite will be five individuals, and the target number of composite samples per collection area will be five. 2. Inorganic arsenic analysis will be performed on 20 percent of samples. Similar arsenic speciation will be inferred for the remaining samples. 3. PCB congener analysis will be performed for as many congeners as practical by the analytical laboratory on 20 percent of the samples. The 20 percent will be composed of one of the five composite samples for each species at each FSCA. The remaining samples will be analyzed for the dioxin-like congeners on the WHO list and an additional select group of congeners that are most common in the first group of samples. Final decisions on the number of additional congeners to be analyzed will be made after review of the first set of analyses.
(6)	Document the operational details and theoretical assumptions of the selected design in sampling and analysis plan	Section 3 provides the operational details and assumptions for the fish tissue sampling design.

Wildlife Risk Assessment DQOs

Step 1. State the Problem—Wildlife Risk Assessment

(1)	Identify members of the planning team	Kevin Rochlin and Sally Thomas—USEPA TOPOs Burt Shephard, Marc Stifelman—USEPA Risk Assessors Jim Stefanoff—CH2M HILL Project Manager Chuck Gruenenfelder—CH2M HILL RI Task Leader Dennis Shelton—CH2M HILL Risk Assessment Task Leader Frank Dillon— CH2M HILL Lead Biologist Artemis Antipas—CH2M HILL Quality Assurance Officer/Chemist John Skalski—Statistical Assessment Consultant
(2)	Identify the primary decision-maker	Decisions will be made by consensus between the USEPA managers and risk assessment task leaders.
(3)	Develop a concise description of the problem	Contaminants may be present in fish and invertebrates at concentrations that pose unacceptable risk to wildlife (birds and mammals) in the UCR site.
(4)	Specify available resources and relevant deadlines for the study	Historical fish tissue data are not of adequate quality or coverage to assess potential risk. Phase I sampling is scheduled for September to November 2005. Project resources are described in Section 3. The need for and schedule of additional sediment sampling events will be determined following evaluation of Phase I data.

Step 2. Identify the Decision—Wildlife Risk Assessment

(1)	Identify the principal study question	Determine whether measures are needed to prevent exposure of wildlife (via consumption of whole fish and invertebrates from the UCR) to contaminant concentrations that pose unacceptable risk.
(2)	Define alternative actions that could result from resolution of the principal study question	(a) No action. (b) Additional data are needed. (c) Remedial action alternatives are developed.
(3)	Combine the principal study question and the alternative actions into a decision statement	Compare representative COI concentrations to risk-based concentrations protective of wildlife and determine the appropriate action: no action, additional data collection, or remedial action development.
(4)	Organize multiple decisions	If the weight of evidence indicates that wildlife communities are not potentially at risk, with low uncertainty about the result, then no further action may be taken. If the weight of evidence indicates that wildlife communities are not potentially at risk, with moderate to high uncertainty about the result, then additional data collection may be necessary. If the weight of evidence indicates that wildlife communities are potentially at risk, with moderate to high uncertainty about the result, then additional data collection may be necessary. If the weight of evidence indicates that wildlife communities are potentially at risk, with low uncertainty about the result, then remedial action alternatives will need to be developed.

Step 3. Identify Inputs to the Decision—Wildlife Risk Assessment

(1)	Identify information that will be required to resolve the decision statement	Defined conceptual exposure model. Measured contaminant levels in fish (i.e., whole body) from the UCR. Food web model HQ results. Identification of the wildlife receptors being modeled. Ingested dose. TRVs for wildlife species. Food habits of the wildlife receptors. Foraging or home range information for the receptors of concern, and dietary ingestion rates for the selected receptors.
(2)	Determine the sources for each item of information required	Wildlife home ranges and migration patterns. Habitat maps. Chemical analysis of Phase I fish tissue samples (analytes listed in Table 2-3). Benthic tissue analytical data (if available) or modeled data.
(3)	Identify the information that is needed to establish the action level	Food web model HQ results. Length, weight, and age of each fish analyzed.
(4)	Confirm the appropriate measurement methods exist to provide the necessary data	Methods consistent with the above needs are identified in Section 3.

Step 4. Define the Boundaries for the Study—Wildlife Risk Assessment

(1)	Specify the characteristics that define the population of interest	Selected fish species (Table 2-2) from the UCR that are potentially consumed by wildlife. Potential contaminants include metals, PCBs, and dioxins/furans (specific metals and congeners are listed in Table 2-3).
(2)	Define the spatial boundary of the decision statement	Decisions will be made using a variety of spatial boundaries as determined by the conceptual exposure model and the pattern of contaminant concentrations in fish tissue across the site (note that the Phase I study area is bounded by the U.S.-Canadian Border and Grand Coulee Dam.
(3)	Define the temporal boundary of the decision statement	Phase I sampling will be completed in November 2005; decisions regarding risk or need for additional data are expected to be made within 2 years after Phase I data are received.
(4)	Define the scale of decision-making	The scale of the decision will be made based on the conceptual exposure model and the pattern of contaminant concentrations in fish tissue across the site. The smallest decision-making unit may include approximately one-third of the study area.

(5)	Identify practical constraints on data collection	Data collection and analysis may be constrained by limitations in funds currently obligated for this study. In addition, holding times for some contaminants, including mercury, may be exceeded depending on available funds and laboratory capacity The exposure units may range in size from individual reaches (e.g., upper, lower, and middle) to the entire UCR site. The distribution of fish is not homogeneous throughout the study area. Therefore, collection of statistically optimal numbers of target fish species and size ranges in all collection areas may not be feasible. Sampling contingencies are discussed in Section 3.1.6.

Step 5. Develop a Decision Rule—Wildlife Risk Assessment

(1)	Specify the statistical parameter that characterizes the population of interest	The study will analyze composite samples of five individual fish fillets or offal. Depending on availability of fish, a minimum of three individuals may be used. Composites will be randomly assigned for a specified species and location to allow estimates of variability among individual fish. Variance estimates will be used to make inferences about the target population at various levels of confidence, or sample maximums may be used. Inferences may be extended to species not collected based on similar feeding patterns or ecological niche. Results will be presented by species, tissue type, and location.
(2)	Specify the action level for the study	Receptor-specific protective concentrations will also be developed for use in the wildlife risk assessment.
(3)	Develop a decision rule (an "if...then..." statement	If representative COI concentrations are above protective concentrations, a remedial action alternative will need to be developed; otherwise, no further evaluation is necessary.

Step 6. Specify Tolerable Limits on Decision Errors—Wildlife Risk Assessment

(1)	Determine the range of the parameters of interest	Analytical results for historical fish tissue samples have been reviewed and compiled in a database from which the potential ranges of certain contaminant concentrations have been derived. However, the expected range may differ from historical results because of differences in sample locations, collection dates, and types of tissue analyzed.

(2)	Identify the decision errors and choose a null hypothesis	Decision errors and precision were analyzed in terms of relative percent differences between sample means. Decision errors were estimated for a range of relative differences in concentrations over a range of alpha (α), coefficient of variability (CV), and sample size (n) in Figures 1 and 2 of a statistical assessment technical memorandum prepared for the fish tissue sampling program (Skalski 2005; provided in Appendix D of this QAPP). The relative error will decrease with smaller estimates of CV and larger sample sizes. Because different types of fish samples are distributed throughout the study area, the probability of decision errors will increase with the specificity of the analysis (i.e., decision errors will be higher for inferences related to a specific reach versus the entire study area). For example, in Figure 2, if the CV is 0.55 and α is 0.05), the power to detect a 50 percent difference in concentrations is 90 percent for an n of 10 samples (the number of rainbow trout for each of the three reaches) and approaches 100 percent for n of 30 (the total number of rainbow trout collected in all three river reaches The PARCC criteria listed in this QAPP and the minimum detection limits listed in Tables 2-4 and 2-5 will be used to evaluate the usability of analytical data in making decisions about potential risk. Analyte-specific accuracy and precision ranges are shown in Table 2-5. The project completeness target is set at 90 percent. Because the error for precision and accuracy is on average about 30 percent, the consequences of decision errors based on sample results less than half the specified detection levels or greater than twice the specified detection levels are expected to be relatively small.
(3)	Specify a range of possible values of the parameter of interest where the consequences of decision error are relatively minor	Based on resource constraints relative to the large study area, as well as uncertainties in exposure and toxicity data used to describe risk, the ability to estimate tissue concentrations with a relative area error of 50 percent is considered acceptable or minor.
(4)	Assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors.	The methods and probability values to be used in evaluating decision errors relative to action levels will be described in a Statistics Assessment Technical Memorandum.

Step 7. Optimize the Design—Wildlife Risk Assessment

(1)	Review the DQO outputs and existing data	See Steps 1 to 6.
(2)	Develop general data collection design alternatives	The rationale for the sampling design is described in the Fish Tissue A&R Document (CH2M HILL 2005b). The sampling program is summarized in Table 2-2.
(3)	Formulate the mathematical expressions necessary for each design alternative	The methods to be used in aggregating data and evaluating results for the wildlife risk assessment will be described in a Statistics Assessment Technical Memorandum.
(4)	For each data collection design alternative, select the optimal sample size that satisfies the DQOs	The sampling approach and sample sizes are described in Table 2-2.

(5)	Select the most resource-effective data collection design that satisfies the DQOs	The rationale for the sampling design is described in the Fish Tissue A&R Document (CH2M HILL 2005b). This design includes (a) sampling five species of fish that represent major potential food sources for wildlife species, (b) analyzing samples as whole fish, and (c) composite sampling to allow for a broader representation of the average exposure area for the target species. The sampling program is summarized in Table 2-2. Target analytes and are listed in Table 2-3. The following specific steps will be take to minimize analytical costs while providing the necessary data: 1. A composite sample approach will be used for all fish species at all sites in this study (USEPA 2000c). The target number fish per composite will be five individuals, and the target number of composite samples per collection area will be five. 2. Inorganic arsenic analysis will be performed on 20 percent of samples. Similar arsenic speciation will be inferred for the remaining samples. 3. PCB congener analysis will be performed for as many congeners as practical by the analytical laboratory on 20 percent of the samples. The 20 percent will be composed of one of the five composite samples for each species at each FSCA. The remaining samples will be analyzed for the dioxin-like congeners on the WHO list and an additional select group of congeners that are most common in the first group of samples. Final decisions on the number of additional congeners to be analyzed will be made after review of the first set of analyses and consultation with the USEPA TOPO.
(6)	Document the operational details and theoretical assumptions of the selected design in sampling and analysis plan	Section 3 provides the operational details and assumptions for the fish tissue sampling design.

2.4.2 Measurement Performance Criteria

The quality assurance (QA) objective of this plan is to identify procedures and criteria that will provide data of known and appropriate quality for the needs identified in Section 2.4.1. Data quality is assessed by precision, accuracy, representativeness, comparability, and completeness (PARCC). These parameters, the applicable procedures, and level of effort are described below.

The applicable quality control (QC) procedures, quantitative target limits, and level of effort for assessing data quality are dictated by the intended use of the data as well as the nature of the analytical methods. Analytical parameters, analytical methods, applicable detection levels, and analytical precision, accuracy, and completeness in alignment with needs identified in Section 2.4.1 are presented in Table 2-5. Analytical methods and quality control procedures are further detailed in Section 3.

Target detection limits listed in Table 2-4 are designated as "target" limits because the final sample detection levels may be higher as a result of sample matrix effects and the percent moisture and percent lipids of the samples. Detection levels for the individual samples will be reported in the final data. As described in Section 2.4.1, some of the reporting levels may be higher than calculated risk levels. The selected methods are state of the art and are what is practicable for this study. Laboratory-specific MDLs are significantly below reporting levels. Where reporting limits are higher than calculated risk levels, the project team will use MDLs as needed for project decisions.

Following are definitions and levels of effort for the data assessment parameters:

Representativeness is a measure of how closely the results reflect the actual concentration or distribution of the chemical compounds in the matrix samples. Sampling plan design, sampling techniques, and sample-handling protocols (for example, for storage, preservation, and transportation) have been developed and are discussed in Section 3 of this document.

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using defined procedures and the use of consistent methods and consistent units. Actual detection limits will depend on the sample matrix and will be reported as defined for the specific samples. In addition, to ensure comparability of this study to historic studies, a data review was conducted (CH2M HILL 2005b). Information from those previous studies, including fish species, sample locations, and analytes, were used to help guide development of the current study design.

Accuracy is an assessment of the closeness of the measured value to the true value. For samples, accuracy of chemical test results is assessed by spiking samples with known standards and establishing the average recovery. For a matrix spike, known amounts of a standard compound containing a subset of the compounds being measured are added to the sample. A quantitative definition of average recovery accuracy is given in Section 5.3. Accuracy measurement will be carried out with a minimum frequency of 1 in 20 samples analyzed.

For measurements where matrix spikes are used, the following approach will be used:

$$\%R = 100\% \times \left[\frac{S - U}{C_{sa}}\right]$$

where:

%R	=	percent recovery
S	=	measured concentration in spiked aliquot
U	=	measured concentration in unspiked aliquot
C_{sa}	=	actual concentration of spike added

For situations where an standard reference material (SRM) is used instead of or in addition to matrix spikes, use the following:

$$\%R = 100\% \times \left[\frac{C_m}{C_{sm}}\right]$$

where:

%R	=	percent recovery
C_m	=	measured concentration of SRM
C_{sm}	=	actual concentration of SRM

Precision of the data is a measure of the data spread, when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference; a quantitative definition is given in Section 5.3. The level of effort for precision measurements will be a minimum of 1 in 20 samples.

If calculated from duplicate measurements, the following approach will be used:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

If calculated from three or more replicates, use relative standard deviation (RSD) rather than RPD), as follows:

$$RSD = (s / \bar{y}) \times 100\%$$

where:

RSD	=	relative standard deviation
s	=	standard deviation
$\bar{y}$	=	mean of replicate analyses

Standard deviation, s, is defined as follows:

$$s = \sqrt{\sum_{i=1}^{n} \frac{(y_i - y)^2}{n-1}}$$

where:

s	=	standard deviation
y_i	=	measured value of the i^{th} replicate
$\bar{y}$	=	mean of replicate analyses
n	=	number of replicates

Completeness is a measure of the amount of valid data obtained from the analytical measurement system and the complete implementation of defined field procedures. The

quantitative definition of completeness is given in Section 5.3. The target completeness objective will be 90 percent; the actual completeness may vary depending on the intrinsic nature of the samples. The completeness of the data will be assessed during QC reviews.

Completeness for all measurements will be defined as follows:

$$\%C = 100\% \times \left[\frac{V}{T}\right]$$

where:

%C	=	percent completeness
V	=	number of measurements judged valid
T	=	total number of measurements

2.5 Special Training/Certification (A8)

All project staff working on the site will be health and safety trained, and will follow requirements specified in the project's FSI (Appendix A). The FSI describes the specialized training required for personnel on this project, and the documentation and tracking of this training is included in the FSI.

All sampling team members will be trained biologists experienced in sampling and handling fish for chemical analysis. Each sample crew will lead by an STL who is a trained fisheries biologist experienced in a variety of fish sampling techniques.

2.6 Documents and Records (A9)

Project documentation will be prepared in accordance with USEPA's Region 10 AES Program Plan (USEPA 2003). An important part of project documentation is the sample record. A sample is physical evidence collected from a hazardous waste site, from the immediate environment, or from another source. Because of the potential evidentiary nature of samples, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence. There are a number of field documents for tracking and recording sample custody.

Field documents including sample custody seals, chain-of-custody records, and packing lists will be obtained from the RSCC in USEPA's Quality Assurance Office. Chain-of-custody procedures will be used to maintain and document sample collection and possession. After sample packaging, one or more of the following chain-of-custody forms will be completed, as necessary, for the appropriate samples:

- Organic traffic report and chain-of-custody record; Forms II LITE as applicable
- Inorganic traffic report and chain-of-custody record; Forms II LITE as applicable
- USEPA Region 10 Chain-of-Custody Record
- Overnight shipping courier air bill

Copies of the above forms will be filled out and distributed in accordance with the instructions provided below and in Section 3.3 for sample shipping and documentation. Completed field QA/QC summary forms will be sent to the RSCC at USEPA's Region 10 Quality Assurance Office at the conclusion of the sampling event.

The laboratories will provide CLP or CLP-equivalent data and electronic deliverables.

The following subsections summarize the procedures for documentation of sample handling and custody. Section 2.6.1 discusses general chain-of-custody procedures from field collection through laboratory analysis, and Sections 2.6.2 and 2.6.3 describe field recordkeeping and offsite processing laboratory recordkeeping, respectively. Sample handling and custody procedures in the analytical laboratories will be performed in accordance with analytical laboratory protocols. Detailed sample handling and custody procedures are presented in Section 3.3.

2.6.1 General Chain-of-Custody Procedures

Because samples collected during any investigation could be used as evidence, their possession must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. Chain-of-custody procedures are followed to document sample possession as described below.

2.6.1.1 Definition of Custody

A sample is under custody if one or more of the following criteria are met:

- It is in your possession.
- It is in your view, after being in your possession.
- It was in your possession and then you locked it up to prevent tampering.
- It is in a designated secure area.

2.6.1.2 Field Custody

In collecting samples for evidence, only enough to provide a good representation of the media being sampled will be collected. To the extent possible, the quantity and types of samples and sample locations are determined before the actual fieldwork. As few people as possible should handle samples. The field sampler is personally responsible for the care and custody of the samples collected until they are transferred or dispatched properly.

The PM determines whether proper custody procedures were followed during the field work, and decides whether additional samples are required.

2.6.1.3 Transfer of Custody and Shipment

Samples are accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving the samples sign, date, and note the time on the record. This record documents custody transfer from the sampler, often through another person, to the recipient at the offsite processing laboratory or the analytical laboratory.

Samples are packaged properly for shipment and dispatched to the appropriate laboratory for processing or analysis, with a separate chain-of-custody record accompanying each shipping container. Shipping containers will be sealed with custody seals for shipment to

the laboratory. Courier names and other pertinent information are entered in the "Received by" section of the chain-of-custody record (an example of the chain-of-custody form is provided in Appendix B).

Whenever samples are split with a facility owner or agency, it is noted in the remarks section of the chain-of-custody record. The note indicates with whom the samples are being split, and is signed by both the sampler and recipient. If the split is refused, this will be noted and signed by both parties. If a representative is unavailable or refuses to sign, this is noted in the remarks section of the chain-of-custody record. When appropriate, as in the case where the representative is unavailable, the chain-of-custody record should contain a statement that the samples were delivered to the designated location at the designated time.

All shipments are accompanied by the chain-of-custody record identifying its contents. The original record and one copy accompany the shipment to the laboratory, and a second copy is retained by the PM.

Freight bills, postal service receipts, and bills of lading are retained as part of the permanent documentation.

2.6.1.4 Laboratory Custody

A designated sample custodian accepts custody of the shipped samples and verifies that the packing list sample numbers match those on the chain-of-custody records. Pertinent information as to shipment, pickup, and courier is entered in the "Remarks" section. The custodian then enters the sample numbers into a bound notebook, which is arranged by project code and station number.

The laboratory custodian uses the sample identification number or assigns a unique laboratory number to each sample, and is responsible for seeing that all samples are transferred to the proper processor or analyst or stored in the appropriate secure area.

The custodian distributes samples to the appropriate processors or analysts. Laboratory personnel are responsible for the care and custody of samples from the time they are received, until the sample is exhausted or returned to the custodian. The data from sample processing and analyses are recorded on the laboratory report form.

When sample processing or analyses and necessary QA checks have been completed in the laboratory, the unused portion of the sample will be disposed of properly. All identifying stickers, data sheets, and laboratory records are retained as part of the documentation. Sample containers and remaining samples are disposed of by the laboratory in compliance with all federal, state, and local regulatory requirements.

2.6.2 Field Recordkeeping

To ensure thorough recordkeeping, standardized forms and procedures will be used for recording field activities and sampling data. Notebook entries, field forms, and chain-of-custody forms will be recorded in waterproof, indelible ink. If errors are made on these documents, field team personnel will draw a single line through the error and enter the correct information. Corrections will be initialed and dated by the person performing the correction. If possible, the individual who made the error will correct it.

The FTL will ensure that each field notebook page and field form is completed, copied, and sent to the data manager approximately weekly during the sampling event. After each sample shipment, the SPC will use Forms II Lite™ to export and e-mail electronic copies of the chain-of-custody forms to the USEPA QAO, the offsite processing laboratory, the project chemist, and the data manager. This information will serve as notification of samples being shipped and of the field crew's sampling progress.

The principal tools that will be used to document collection of the composite fish samples are the sample coding scheme, field form, field notebook, and chain-of custody form. These tools are discussed below.

Documentation of the fish collected from each sample area and information about the sampling location will be recorded on the fish collection form (FCF) provided in Appendix B. One FCF will be completed for each collection with each gear type at each sampling location. The sampling crew on the sampling vessel will fill out the FCF as the length of each fish is checked against the target size range. The use of this preprinted form is intended to cue the field team to record the critical information for each fish in a standardized manner. The FCF will be copied and given to the onshore processing team; the original bound forms will be retained by the sampling crew. The onshore processing team will complete the length-weight form (LWF) (see Appendix B) when the length and weight of each fish is measured at the onshore processing facility. At the onshore processing facility, the FCF and the LWF will be photocopied, and two photocopies will be shipped with the samples to the offsite processing laboratory. The original copy of the LWF will be retained by the onsite SPC.

The FCFs will be bound into the field notebooks that will be used on a daily basis by the fish sampling teams. The field notebooks will have water-resistant pages, and notes will be taken with indelible pens when possible. In wet and rainy conditions, pencil entries also may be used if indelible pens are not functional. All lines of all pages will be used. Any pages not used will be marked through with a line, the author's initials, and the note "Intentionally Left Blank."

Daily entries will be made chronologically and will always begin on the right-hand page of the notebook. The following information will be included as part of the initial daily entry:

- Date
- Time onsite
- Name and signature of the person making the entry
- Weather conditions
- Field personnel present and their roles onsite
- Level of personal protection
- List of onsite visitors and the level of personal protection of the visitors
- Times of starting and stopping work
- Planned daily activities
- Equipment calibration results (if any)
- Any encountered equipment problems
- Any changes in weather, including time of weather change
- Other pertinent observations

A chain-of-custody form or record will accompany each shipment of samples through sampling, laboratory processing, laboratory analysis, data validation, and data storage. Ultimately, the form will become part of the project file. The chain-of-custody form will be used to verify the accuracy and completeness of sample results received from the laboratories. It will also be the source of information to verify laboratory invoices and approve them for payment. Detailed specifications and rationale for chain-of-custody requirements are presented in Section 3.3.1.

Chain-of-custody forms will be completed by the SPC or her appointee based on information provided on the FCF. Chain-of-custody forms will travel with the sample coolers to the processing laboratory to document samples taken, processing and analyses requested, shipping date, and receipt by the laboratory.

Each chain-of-custody form will be signed by the SPC or her appointee to indicate who is responsible for the information on the form, should questions arise. Changes or corrections that may be needed on a chain-of-custody form will be written and initialed on the form before shipping from the field. Changes will not be made after shipping because of the potential for miscommunication that can occur between the field and laboratory, and the likelihood that the change may not get recorded on the copy transmitted to the laboratory.

Each chain-of-custody form will include the following information:

- Project name (not included on any copies sent to laboratory)
- Project number (not included on any copies sent to laboratory)
- Project manager
- Laboratory name
- Laboratory shipping address
- Chain-of-custody identifier
- Carrier name and airbill number
- Site identifier
- Sampling-area identifier
- Individual fish identification codes
- Sampling date
- Sampling time
- Requested processing and/or analysis method
- Name of FTL
- Name of SPC and contact information
- Remarks
- Relinquished/received signatures with dates and times

Chain-of-custody forms will be completed and printed using FORMS II Lite™.

2.6.3 Offsite Processing Laboratory Recordkeeping

To ensure thorough recordkeeping of laboratory activities, standardized forms and procedures will be used to record sample processing activities at the offsite laboratory. Laboratory notebooks, standardized laboratory forms, and chain-of-custody forms will be recorded in pen. If errors are made, laboratory personnel will draw a single line through the

error and enter the correct information. Corrections will be initialed and dated by the person performing the correction. If possible, the person who made the error will correct it.

The laboratory PM will ensure that laboratory notebook pages and standardized laboratory forms are completed, copied, and sent to the data manager approximately weekly during sample processing. After a batch of samples is shipped to an analytical laboratory, the laboratory PM will use Forms II Lite™ to export and e-mail electronic copies of the chain-of-custody forms to the USEPA QAO, the analytical laboratory, the project chemist, and the data manager. This information will serve as notification of samples being shipped and of progress at the processing laboratory.

The principal tools that will be used to document processing of the fish samples include the fish processing form (FPF), laboratory notebook, and chain-of custody form. These tools are described below.

The FPF will be used to record information relevant to fish processing (see Appendix B), including the composite sample identification code, identification numbers for each individual fish in the composite sample, weight of homogenate (fillet or whole body) prepared from each individual fish, and weight of the composite homogenate (fillet or whole body). The use of this preprinted form is designed to cue laboratory personnel to record critical information relevant to each sample in a standardized format. Information from the chain-of-custody form and FCF will be used to help complete the FPF.

Laboratory notebooks will be used to record relevant information not included on the FPFs. Laboratory notebook entries will be made in accordance with the standard operating procedures of the processing laboratory. All entries will be made in pen and will be dated and initialed by the analyst making the entry.

A chain-of-custody form will accompany each shipment of samples from the processing laboratory to the analytical laboratories being used for the UCR Phase I fish investigation. Chain-of-custody forms will be initially completed in the field and sent to the processing laboratory with each shipment of fish. These same forms (or a copy of them) will be included in the coolers that are shipped to the various analytical laboratories. The forms will be signed and dated by the laboratory PM or his/her appointee when the samples are relinquished.

TABLE 2-1
Preliminary Schedule of Activities
Upper Columbia River RI/FS

Activity	Estimated Start Date	Estimated Completion Date
QAPP Review and Approval	08/08/2005	08/31/2005
Mobilization to Site	08/31/2005	09/06/2005
Project Headquarters Setup	08/31/2005	09/06/2005
Stage 1 Sample Collection		
A. FSCA 1	09/06/2005	09/10/2005
B. FSCA 2	09/06/2005	09/10/2005
C. FSCA 3	09/12/2005	09/16/2005
D. FSCA 4	09/12/2005	09/16/2005
E. FSCA 5	09/19/2005	09/24/2005
F. FSCA 6	09/19/2005	09/24/2005
Stage 2 Sample Collection		
A. FSCA 1	10/12/2005	10/14/2005
B. FSCA 2	10/14/2005	10/16/2005
C. FSCA 3	10/18/2005	10/20/2005
D. FSCA 4	10/20/2005	10/22/2005
E. FSCA 5	10/24/2005	10/26/2005
F. FSCA 6	10/26/2005	10/28/2005
Offsite Processing Laboratory Receipt of Samples		
A. First Processing Event	10/17/2005	
B. Second Processing Event	11/21/2005	
C. Third Processing Event	01/02/2006	
D. Fourth Processing Event	01/23/2006	
F. Fifth Processing Event	02/13/2006	
Sample Analysis		CLP—35 days from VTSR MEL—7 weeks from VTSR
Data Validation		3 weeks from data submittal
Preparation of Data Report	05/15/2006	08/15/2006

VTSR = validated time of sample receipt

TABLE 2-2
Summary of Phase I Fish Tissue Sampling
Upper Columbia River RI/FS

Sample Type/Interval	Target Species	Sample Type	Data Uses	Analytical Suite	Quantity
Whole body	Lake whitefish, largescale sucker, burbot	Five composites made up of samples taken in six identified fish sampling areas	Human health risk assessment Aquatic risk assessment Wildlife risk assessment	TAL metals, inorganic arsenic (20% of samples), PCB Aroclors, PCB congeners, dioxins/furan congeners, % moisture, and % lipids (Table 2-4). Archived samples will be available for additional analyses if needed.	90 composite samples (6 sample areas, 5 composite samples per area, 3 species)
	Walleye, rainbow trout	Five composites made up of samples taken in three of six identified fish sampling areas	Human health risk assessment Aquatic risk assessment Wildlife risk assessment	TAL metals, inorganic arsenic (20% of samples), PCB Aroclors, PCB congeners, dioxins/furan congeners, % moisture, and % lipids (Table 2-4). Archived samples will be available for additional analyses if needed.	30 composite samples (3 sample areas, 5 composite samples per area, 2 species)
Fillet and offal	Walleye, rainbow trout	Five composites made up of samples taken in three of six identified fish sampling areas	Human health risk assessment Aquatic risk assessment Wildlife risk assessment	TAL metals, Inorganic arsenic (20% of samples), PCB Aroclors, PCB congeners, dioxins/furan congeners, % moisture, and % lipids (Table 2-4). Archived samples will be available for additional analyses if needed.	60 composite samples (3 sample areas, 5 composite samples per area, 2 species, 2 tissue types)

TABLE 2-3
Potential Risk Criteria
Upper Columbia River RI/FS

Parameter	Potential Ecological Risk Criterion (ug/kg ww)	Human Health Risk			Analytical Concentration Goal (ACG) (ug/kg ww)[b]
		Noncancer Potential Risk Criterion (ug/kg ww)[a]	Cancer 10E-6 Potential Risk Criterion (ug/kg ww)[a]	Cancer 10E-5 Potential Risk Criterion (ug/kg ww)[a]	
TAL Metals[c]					
Aluminum	**4400**[g]	41,000	N/A	N/A	**4,400**
Antimony	**30**	NA	NA	NA	**30**
Arsenic - Total[d]	1600[g]	N/A	**6.4**	64	**6.4**
Barium	NA	**2,900**	N/A	N/A	**2,900**
Beryllium	100	**82**	N/A	N/A	**82**
Cadmium	420[g]	**41**	N/A	N/A	**41**
Calcium	NA	NA	NA	NA	NA
Chromium III	**180**[g]	62,000	N/A	N/A	**180**
Cobalt	NA	**820**	N/A	N/A	**820**
Copper	**300**[g]	1,600	N/A	N/A	**300**
Iron[e]	NA	**25,000**	N/A	N/A	**25,000**
Lead[f]	**60**[g]	80	N/A	N/A	**60**
Magnesium	NA	NA	NA	NA	NA
Manganese	NA	**5,800**	N/A	N/A	**5,800**
Mercury[f]	60[g]	**4**	N/A	N/A	**4**
Nickel	**390**[g]	820	N/A	N/A	**390**
Potassium	NA	NA	NA	NA	NA
Selenium	560[g]	**210**	N/A	N/A	**210**
Silver	**37**[g]	210	N/A	N/A	**37**
Sodium	NA	NA	NA	NA	NA
Thallium	4,600	**3**	N/A	N/A	**3**
Uranium	NA	**8**	N/A	N/A	**8**
Vanadium	NA	**41**	N/A	N/A	**41**
Zinc	20000[g]	**12,400**	N/A	N/A	**12,400**
Arsenic - Inorganic					
Arsenic - Inorganic[d]	NA	N/A	**0.64**	6.4	**0.64**
PCB Aroclors					
Aroclor 1016	440[g]	**1.40**	N/A	N/A	**1.40**
Aroclor 1221	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1232	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1242	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1248	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1254	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1260	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1262	440[g]	N/A	**0.5**	5	**0.5**
Aroclor 1268	440[g]	N/A	**0.5**	5	**0.5**
PCB Congeners					
PCB -77	**0.06**[h]	N/A	**0.067**	0.67	**0.06**
PCB-81	**0.06**[h]	N/A	**0.067**	0.67	**0.06**
PCB-105	**0.06**[h]	N/A	**0.067**	0.67	**0.06**
PCB-114	0.06[h]	N/A	**0.013**	0.13	**0.013**
PCB-118	**0.06**[h]	N/A	**0.067**	0.67	**0.06**
PCB-123	**0.06**[h]	N/A	**0.067**	0.67	**0.06**
PCB-126	0.06[h]	N/A	**0.000067**	0.00067	**0.000067**
PCB-156	0.06[h]	N/A	**0.013**	0.13	**0.013**
PCB-157	0.06[h]	N/A	**0.013**	0.13	**0.013**
PCB-169	0.06[h]	N/A	**0.00067**	0.0067	**0.00067**
PCB-189	**0.06**[h]	N/A	**0.067**	0.67	**0.06**
All other PCB Congeners	**0.06**[h]	0.86	N/A	N/A	**0.06**

TABLE 2-3
Potential Risk Criteria
Upper Columbia River RI/FS

Parameter	Potential Ecological Risk Criterion (ug/kg ww)	Human Health Risk			Analytical Concentration Goal (ACG) (ug/kg ww)[b]
		Noncancer Potential Risk Criterion (ug/kg ww)[a]	Cancer 10E-6 Potential Risk Criterion (ug/kg ww)[a]	Cancer 10E-5 Potential Risk Criterion (ug/kg ww)[a]	
Dioxins/Furans (tetra through octa)					
2,3,7,8-TCDD	0.006	N/A	**0.00001**	0.00007	**0.00001**
1,2,3,7,8-PeCDD	0.006	N/A	**0.00001**	0.00007	**0.00001**
1,2,3,6,7,8-HxCDD	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,4,7,8-HxCDD	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,7,8,9-HxCDD	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,4,6,7,8-HpCDD	0.006	N/A	**0.00067**	0.00668	**0.00067**
OCDD	**0.006**	N/A	0.06680	0.66800	**0.006**
2,3,7,8-TCDF	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,7,8-PeCDF	0.006	N/A	**0.00013**	0.00134	**0.00013**
2,3,4,7,8-PeCDF	0.006	N/A	**0.00001**	0.00013	**0.00001**
1,2,3,6,7,8-HxCDF	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,7,8,9-HxCDF	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,4,7,8-HxCDF	0.006	N/A	**0.00007**	0.00067	**0.00007**
2,3,4,6,7,8-HxCDF	0.006	N/A	**0.00007**	0.00067	**0.00007**
1,2,3,4,6,7,8-HpCDF	0.006	N/A	**0.00067**	0.0067	**0.00067**
1,2,3,4,7,8,9-HpCDF	0.006	N/A	**0.00067**	0.0067	**0.00067**
OCDF	**0.006**	N/A	0.067	0.67	**0.006**
Conventionals					
% Lipids	N/A	N/A	N/A	N/A	N/A
% Moisture	N/A	N/A	N/A	N/A	N/A

[a] For the purposes of evaluating achievable levels of detection in fish tissue, risk-based concentrations are based on an assumed target risk range of 1x10-6 to 1x10-5 for carcinogens or an HQ of 0.1 for noncarcinogens or ecological endpoints, unless otherwise noted. Although a fish consumption rate of 170 grams per day (every day for 30 years) was assumed for these estimates, the baseline risk assessment will evaluate a wider range of consumption rates.

[b] ACGs are the lower of the potential ecological and human health risk criteria.

[c] Potential human health risk criteria for TAL metals were taken from USEPA Region 3 PRG Tables modified using the assumptions listed in Footnote [a] unless otherwise noted.

[d] Assumed 10 percent inorganic arsenic.

[e] Stifelman, M.L., L. Ingerman, W.C. Thayer, and G.L. Diamond. 2005. Abstract No. 2082: Risk Assessment for Iron: Use of the Institute of Medicine's Tolerable Upper Intake Level as a Surrogate Toxicity Value for Iron. Society of Toxicology 44th Annual Meeting, 2005. New Orleans, LA. *The Toxicologist CD — An Official Journal of the Society of Toxicology*. Volume 84, S-1. http://www.toxicology.org/AI/FA/2005_Toxicologist.pdf

[f] Calculated using IEUBK lead model assuming child (0 to 84 months) fish ingestion rate of 170 grams/day, resulting in 5.035 percent of population with blood lead levels above 10 ug/dL.

[g] Dyer, S.D., C.E. White-Hull, and B.K. Shephard. 2000. Assessments of Chemical Mixtures via Toxicity Reference Values Overpredict Hazard to Fish Communities. *Environ. Sci. Technology 2000*, 34:2518-2524.

[h] Windward. 2004. *Lower Duwamish Waterway. Quality Assurance Project Plan: Fish and Crab Tissue Collection and Chemical Analysis*. Appendices A to E.

[i] Anaysis will be for total mercury. It is assumed that all mercury in fish tissue will be as methlymercury.

Notes:
All values are expressed as wet weight.
Bold values are ACGs.
Archives of samples will be retained and remain available for analysis of analytes not included in this table.

NA = not available
N/A = not applicable
PRG = preliminary remediation goal
ug/dL = microgram per deciliter
ug/kg = microgram per kilogram

TABLE 2-4
Analytical Concentration Goals and Corresponding Analytical Limits
Upper Columbia River RI/FS

Parameter	Analytical Concentration Goal (ug/kg)	Contract-Required Quantitation Limits[a] (µg/kg)	
		CLP Method[b]	MEL Method[c]
TAL Metals			
Aluminum	4,400	TBD	TBD
Antimony	30	TBD	TBD
Arsenic	6.4	TBD	TBD
Barium	2,900	TBD	TBD
Beryllium	82	TBD	TBD
Cadmium	41	TBD	TBD
Calcium	NA	TBD	TBD
Chromium III	180	TBD	TBD
Cobalt	820	TBD	TBD
Copper	300	TBD	TBD
Iron	25,000	TBD	TBD
Lead	60	TBD	TBD
Magnesium	NA	TBD	TBD
Manganese	5,800	TBD	TBD
Mercury[d]	4	TBD	TBD
Nickel	390	TBD	TBD
Potassium	NA	TDB	TDB
Selenium	210	TDB	TDB
Silver	37	TDB	TDB
Sodium	NA	TDB	TDB
Thallium	3	TDB	TDB
Uranium	8	TDB	TDB
Vanadium	41	TDB	TDB
Zinc	12,400	TDB	TDB
PCB Aroclors			
Aroclor 1016	1.4	TBD	TBD
Aroclor 1221	0.5	TBD	TBD

TABLE 2-4
Analytical Concentration Goals and Corresponding Analytical Limits
Upper Columbia River RI/FS

Parameter	Analytical Concentration Goal (ug/kg)	Contract-Required Quantitation Limits[a] (µg/kg)	
		CLP Method[b]	MEL Method[c]
Aroclor 1232	0.5	TBD	TBD
Aroclor 1242	0.5	TBD	TBD
Aroclor 1248	0.5	TBD	TBD
Aroclor 1254	0.5	TBD	TBD
Aroclor 1260	0.5	TBD	TBD
Aroclor 1262	0.5	TBD	TBD
Aroclor 1268	0.5	TBD	TBD
PCB Congeners			
PCB-77	0.06	TBD	TBD
PCB-81	0.06	TBD	TBD
PCB-105	0.06	TBD	TBD
PCB-114	0.013	TBD	TBD
PCB-118	0.06	TBD	TBD
PCB-123	0.06	TBD	TBD
PCB-126	0.000067	TBD	TBD
PCB-156	0.013	TBD	TBD
PCB-157	0.013	TBD	TBD
PCB-169	0.00067	TBD	TBD
PCB-189	0.06	TBD	TBD
All other PCB congeners	0.06	TBD	TBD
Dioxins/Furans			
2,3,7,8-TCDD	0.00001	TBD	TBD
1,2,3,7,8-PeCDD	0.00001	TBD	TBD
1,2,3,6,7,8-HxCDD	0.00007	TBD	TBD
1,2,3,4,7,8-HxCDD	0.00007	TBD	TBD
1,2,3,7,8,9-HxCDD	0.00007	TBD	TBD
1,2,3,4,6,7,8-HpCDD	0.00067	TBD	TBD
OCDD	0.006	TBD	TBD

TABLE 2-4
Analytical Concentration Goals and Corresponding Analytical Limits
Upper Columbia River RI/FS

Parameter	Analytical Concentration Goal (ug/kg)	Contract-Required Quantitation Limits[a] (µg/kg)	
		CLP Method[b]	MEL Method[c]
2,3,7,8-TCDF	0.00007	TBD	TBD
1,2,3,7,8-PeCDF	0.00013	TBD	TBD
2,3,4,7,8-PeCDF	0.00001	TBD	TBD
1,2,3,6,7,8-HxCDF	0.00007	TBD	TBD
1,2,3,7,8,9-HxCDF	0.00007	TBD	TBD
1,2,3,4,7,8-HxCDF	0.00007	TBD	TBD
2,3,4,6,7,8-HxCDF	0.00007	TBD	TBD
1,2,3,4,6,7,8-HpCDF	0.00067	TBD	TBD
1,2,3,4,7,8,9-HpCDF	0.00067	TBD	TBD
OCDF	0.006	TBD	TBD

[a] Limits for fish tissue will be laboratory specific. The laboratories will use the best available science to target the ACGs.

[b] Tissue MDLs and MRLs will be submitted by the designated CLP laboratory prior to contract award. The MDLs and MRLs will be incorporated in the QAPP as an addendum.

[c] Tissue MDLs and RLs for MEL will be incorporated in the QAPP as an addendum.

[d] It is assumed that all mercury will be methylmercury.

MRL = method reporting limit
RL = reporting limit
TBD = to be determined

TABLE 2-5
Measurement Performance Criteria
Upper Columbia River RI/FS

Analytes[a]	Units	Target Detection Limit[b]	Analytical Precision (Relative Percent Deviation)[b]	Analytical Accuracy (Percent Recovery)[b]	Overall Completeness (%)	Method[b]	Reference[b]	Sample Holding Time	Container	Preservation
TAL Metals and Uranium	mg/kg ww	See Table 2-3	CLP/ MEL	CLP/ MEL	90	CLP/ ILM05.3/SW846-6000/7000	CLP/ MEL	6 months[c]	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C
PCBs (Aroclors)	µg/kg ww	See Table 2-3	CLP/ MEL	CLP/ MEL	90	CLP/ OLM04.3/SW8082	CLP/ MEL	6 months	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C
PCBs (congeners)	µg/kg ww	See Table 2-3	CLP/ MEL	CLP/ MEL	90	Method 1668A	CLP/ MEL	1 year	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C
Inorganic Arsenic	µg/kg ww	See Table 2-3	MEL	MEL	90	MEL	MEL	1 year	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C
Dioxins/ Furans (tetra through octa)	µg/kg ww	See Table 2-3 MEL	CLP/ MEL	CLP/ MEL	90	Method 1613B	CLP/ MEL	1 year	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C

TABLE 2-5
Measurement Performance Criteria
Upper Columbia River RI/FS

Analytes[a]	Units	Target Detection Limit[b]	Analytical Precision (Relative Percent Deviation)[b]	Analytical Accuracy (Percent Recovery)[b]	Overall Completeness (%)	Method[b]	Reference[b]	Sample Holding Time	Container	Preservation
% Lipids	Percent	0.1%	NA	NA	90	Bligh and Dyer[d] modified per MEL	CLP/ MEL	1 year	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C
% Moisture	Percent	0.1%	NA	NA	90	PSEP[e]	CLP/ MEL	1 year	Aluminum foil (whole fish) Glass jar with PTFE-lined cap (homogenate)	Frozen at –20°C

[a] Specific analytes are shown in Table 2-4.

[b] Detection limits, precision, accuracy, and methods will be fish tissue and laboratory-specific. The laboratories will target the ACGs shown in Table 2-3.The tissue MRLs and MDLs for MEL and the CLP laboratory will be provided in an addendum following final determination of analytical laboratories.

[c] USEPA-recommended holding time for samples for mercury analysis is 28 days, but the following agencies have recommended 6 months:

California Department of Fish and Game. 1990. *Laboratory Quality Assurance Program Plan*. Environmental Services Division, Sacramento, CA.

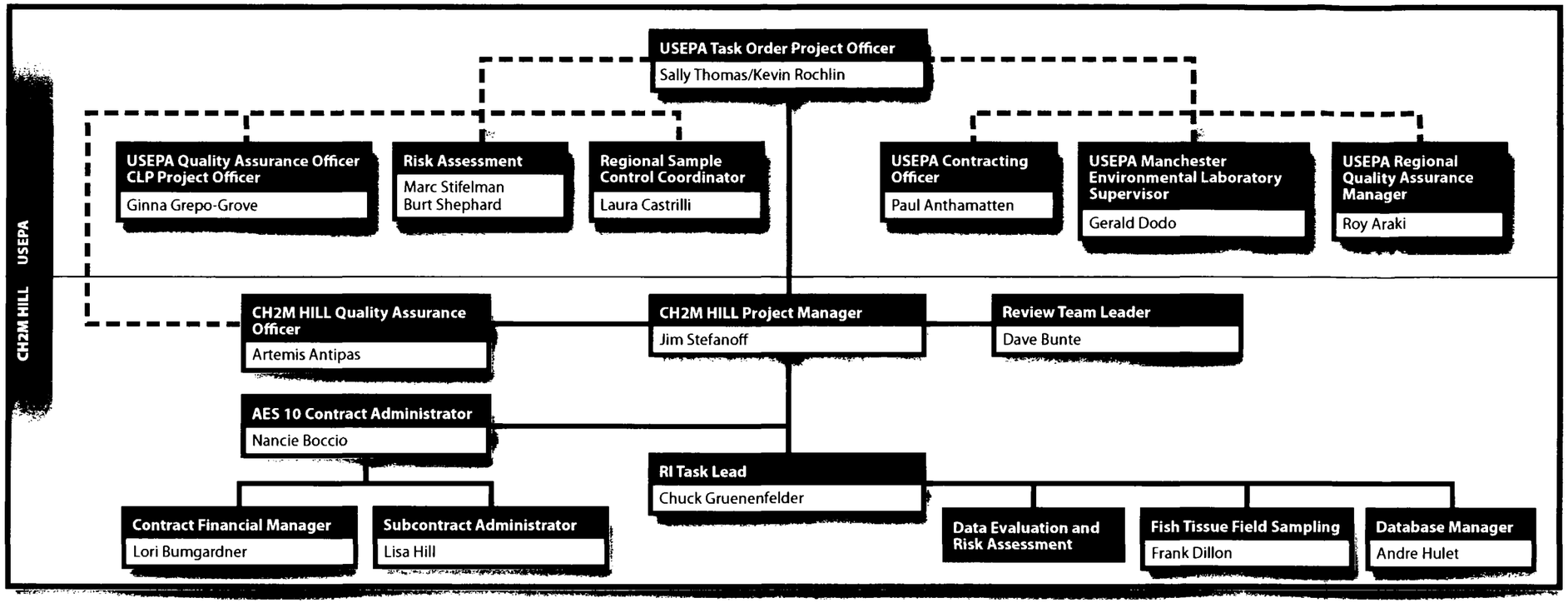
Crawford, J.K., and S.N. Luoma. 1993. *Guidelines for Studies of Contaminants in Biological Tissues for the National Water-Quality Assessment Program*. USGS Open-File Report 92-494. U.S. Geological Survey, Lemoyne, PA..

[d] Bligh, E.G. and W.J. Dyer. 1959. A Rapid Method for Total Lipid Extraction and Purification. *Can. J. Biochem. Physiol.* 37:911-917.

[e] Puget Sound Estuary Program (PSEP). 1997. *Recommended Guidelines for Measuring Metals in Puget Sound Water, Sediment, and Tissue*. Prepared for USEPA Region 10, Office of Puget Sound, WA. TetraTech Inc., Bellevue, WA.

Notes: CLP indicates USEPA CLP methodology and QA/QC.
MEL indicates USEPA Region 10 Manchester Environmental Laboratory methodology and QA/QC.

PSEP = Puget Sound Estuary Program
PTFE = polytetrafluoroethylene (Teflon)
ww = wet weight



NAME	ORGANIZATION (TITLE)	PHONE	EXT.	E-MAIL
Anthamatten, Paul	USEPA (USEPA Contracting Officer)	913.551.7729	direct	anthamatten.paul@epa.gov
Araki, Roy	**USEPA (USEPA Regional Quality Assurance Manager)**	**206.553.6395**	**direct**	**araki.roy@epa.gov**
Castrilli, Laura	USEPA (Regional Sample Control Coordinator)	206.553.4323	direct	castrilli.laura@epa.gov
Dodo, Gerald	**USEPA (USEPA Manchester Environmental Laboratory Supervisor)**	**360.871.8728**	**direct**	**dodo.gerald@epa.gov**
Grepo-Grove, Ginna	USEPA (USEPA Quality Assurance Officer/CLP Project Officer	206.553.1632	direct	grepo-grove.gina@epa.gov
Rochlin, Kevin	**USEPA (USEPA Task Order Project Officer)**	**206.553.2106**	**direct**	**rochlin.kevin@epa.gov**
Shephard, Burt	USEPA (Risk Assessment)	206.553.6359	direct	shephard.burt@epa.gov
Stifelman, Marc	**USEPA (Risk Assessment)**	**206.553.6979**	**direct**	**stifelman.marc@epa.gov**
Thomas, Sally	USEPA (USEPA Task Order Project Officer)	206.553.2102	direct	thomas.sally@epa.gov
Antipas, Artemis	**CH2M HILL/SEA (CH2M HILL Quality Assurance Officer)**	**425.453.5005**	**5051**	**aantipas@ch2m.com**
Boccio, Nancie	CH2M HILL/SEA (AES 10 Contract Administrator)	425.453.5005	5256	nboccio@ch2m.com
Bumgardner, Lori	**CH2M HILL/CVO (Contract Administrator)**	**541.758.0235**	**3393**	**lbumgard@ch2m.com**
Bunte, Dave	CH2M HILL/RDD (Review Team Leader)	530.243.5886	3223	dbunte@ch2m.com
Dillon, Frank	**CH2M HILL/SEA (Sampling Team Leader)**	**425.453.5005**	**5256**	**fdillon@ch2m.com**
Gruenenfelder, Chuck	CH2M HILL/SPK (RI Task Lead)	509.747.2000	231	cgruenen@ch2m.com
Hill, Lisa	**CH2M HILL/SEA (Subcontract Administrator)**	**425.453.5005**	**5043**	**lhill@ch2m.com**
Stefanoff, Jim	CH2M HILL/SPK (CH2M HILL Project Manager)	509.747.2000	202	jstefano@ch2m.com

FIGURE 2-1
Phase 1 Fish Tissue Sampling Project Organization
Upper Columbia River RI/FS

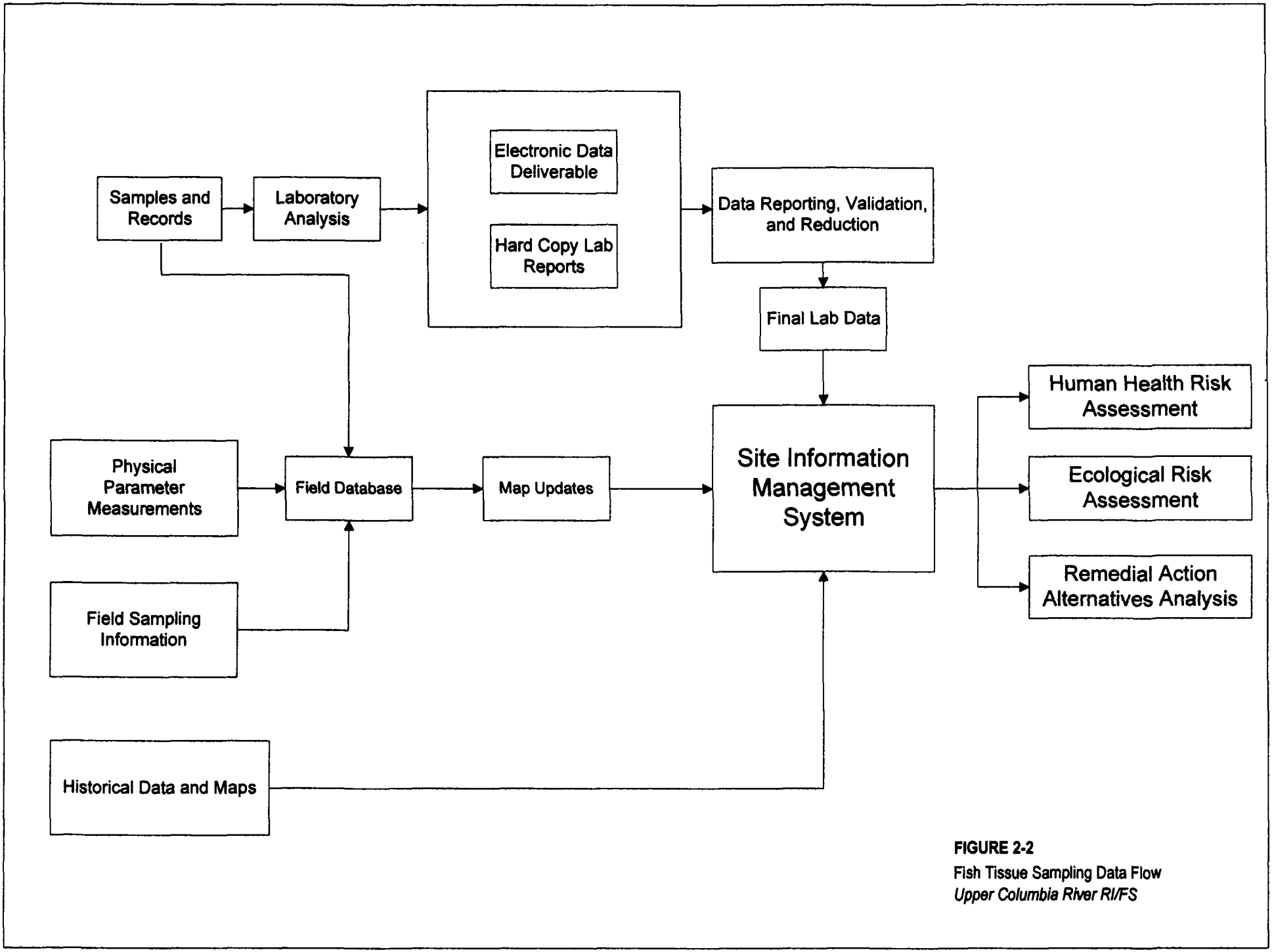
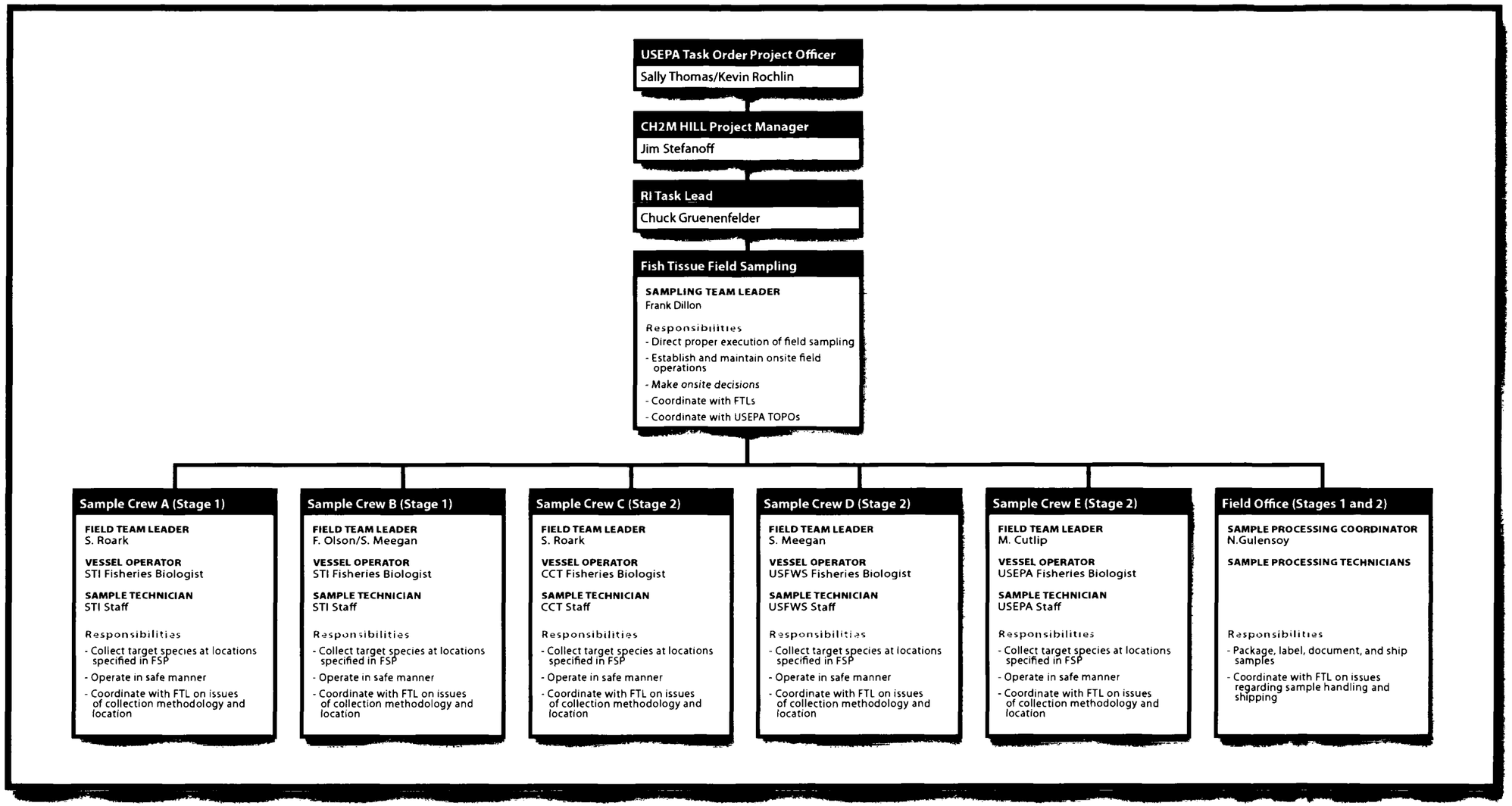


FIGURE 2-2
Fish Tissue Sampling Data Flow
Upper Columbia River RI/FS



TRIBAL AND AGENCY CONTACTS

NAME	ORGANIZATION (TITLE)	PHONE	EXT.	E-MAIL
Crossley, Brian	Spokane Tribe of Indians	509.258.9217	direct	crossley@spokanetribe.com
Sears, Sheri	Confederated Tribes of the Colville Reservation	509.231.6223	direct	sheri.sears@colvilletribes.com
Campbell, Julie	USFWS	509.893.8004	direct	julie_campbell@fws.gov
Terp, Dave	USEPA	206.553.6905	direct	terpening@epa.gov

FIGURE 2-3
Phase 1 Fish Tissue Field Sampling Organization
Upper Columbia River RI/FS

SECTION 3

Data Generation and Acquisition (USEPA Group B)

SECTION 3

Data Generation and Acquisition (USEPA Group B)

3.1 Sampling Design (Experimental Design) (B1)

The rationale for the sampling design was described in the Fish Tissue A&R Document (CH2MHILL 2005b). The sampling design is summarized as follows:

- The site will be divided into three reaches (upper, middle, and lower), as shown in Figure 3-1.
- Two FSCAs will be located in each reach (a total of six FSCAs will be sampled).
- Five of six FSCAs will be co-located the sediment sampling focus areas.
- Rainbow trout, walleye, largescale sucker, lake (or mountain) whitefish, and burbot will be targeted for collection at each of the six selected FSCAs.
- Five composite samples (each composed of five individuals) will be analyzed for each species from each FSCA.
- Whole body samples will be analyzed for all species from all FSCAs, except at one FSCA within each reach, from which fillet and offal will be analyzed separately for each composite for walleye and rainbow trout.
- Analytes include PCB Aroclors, PCB congeners, dioxins and furans, TAL metals, inorganic arsenic, percent lipids, and percent moisture.

3.1.1 Target Species and Lengths

The following fish species will be targeted for collection during the Phase I fish tissue sampling program:

- Walleye *(Sander vitreus)*—a top-level predator that feeds primarily on small fish. Previous studies in Lake Roosevelt have reported higher mercury levels in walleye compared to other species, and there is a state health advisory in place for consumption of walleye from the lake based on mercury concentrations. Large numbers of walleye are harvested by recreational anglers in Lake Roosevelt.
- Rainbow trout *(Oncorhynchus mykiss)*—the most commonly harvested fish in Lake Roosevelt in most years. Both hatchery and wild trout occur in the lake. An attempt will be made to analyze wild and hatchery trout separately to the extent that sufficient samples of identifiable wild fish can be obtained.
- Lake whitefish (*Coregonus clupeaformis*)—one of the most common fish in Lake Roosevelt, but not highly sought by recreational anglers. Juvenile whitefish feed

primarily on zooplankton (mostly *Daphnia*), but their diet gradually shifts to benthic organisms as they become larger.

- Largescale sucker (*Catostomas macrocheilus*)—a bottom feeder that is very abundant in Lake Roosevelt. They feed primarily in the relatively shallow littoral zone on a variety of benthic organisms.

- Burbot (*Lota lota*)—a bottom-dwelling fish that consumes primarily fish, but also feeds on crayfish, amphipods, and fish eggs. Piscivores like this are more likely to accumulate biomagnifying constituents such as mercury in tissues. In addition, because burbot are bottom dwellers, they could accumulate contaminants associated with sediment. A limited tribal and recreational fishery exists for this species.

These fish species were selected using general guidance from *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories—Volume 1, Sampling and Analysis* (USEPA 2000c), as detailed in the Fish Tissue A&R Document (CH2M HILL 2005b). Two of the target species, rainbow trout and walleye, are fish that are commonly consumed by people and are of high recreational or subsistence fishing value in the study area. All five target species have the potential to bioaccumulate chemical contaminants though different feeding behaviors and diets. In addition, the target species are available along the length of the UCR and are known to be (or likely to be) consumed by wildlife. These tissue samples will also be used to assess risk to the fish themselves and to the wildlife that may consume them. Each species can be collected using standard methods, and each has available historical data on contaminants for comparative purposes.

The selected length (total) ranges for each target species to be collected are as follows:

- Walleye—33 to 43 cm (13 to 17 inches)
- Rainbow trout—33 to 43 centimeters (cm) (13 to 17 inches)
- Lake whitefish—33 to 43 cm (13 to 17 inches)
- Largescale sucker—33 to 43 cm (13 to 17 inches)
- Burbot—43 to 56 cm (17 to 22 inches)

The length ranges for rainbow trout and walleye were based on similarity to those typically harvested in the sport fishery, and consistency with lengths evaluated for contaminants in previous studies. Lake whitefish, largescale sucker, and burbot are not commonly harvested in the sport fishery, and, therefore, the length ranges for these species were based on the typical size observed in past scientific collections. These lengths also are within the range used in past contaminant studies in the lake. The lower length within each range is not less than 25 percent smaller than the longer length, in accordance with USEPA guidance (USEPA 2000c). However, if sufficient quantities of targeted length ranges are not obtainable, alternative sizes may be selected. If it is necessary to collect outside the target range, larger fish will initially be accepted before smaller fish are taken.

Length, weight, and age data are needed from fish at all sites due the potential for within-species variation in size-at-age along the length of the UCR, and because contaminant accumulation in fishes may be related to the age of the fish as well as length and weight. The laboratory that will homogenize the composite samples and remove otoliths from each fish <Note: Opercles instead of otoliths will be taken from largescale suckers). The otoliths will be sent to the Washington Department of Fish and Wildlife (WDFW), along with the fish

identification code, for determination of the age of the fish. For each fish submitted for analysis, the age of the fish will be entered into the database along with all of the other information for that fish.

3.1.2 Sample Locations

The five target fish species will be collected from six FSCAs. The number, size, and distribution of the FSCAs were selected to provide data with the following characteristics:

- Coverage of the entire UCR study area
- Similar numbers of fish from each reach: upper (river miles [RM] 710 to 740), middle (RM 640 to 710) and lower (RM 600 to 640)
- Located approximately equal distance apart to detect possible upstream/downstream gradient trends, especially in light of known upstream contaminant sources
- Inclusive of expected high contaminant exposure areas for the target fish species
- Representative of areas where recreational and tribal anglers harvest Lake Roosevelt fish for consumption
- Representative of areas where wildlife may forage for Lake Roosevelt fish
- Overlapping with the sediment sampling focus areas for comparison to sediment contaminant data
- Overlapping with areas evaluated in previous fish contaminant studies

The FSCAs are distributed along the length of the lake, from the U.S.-Canadian border downstream to about 5 miles above Grand Coulee Dam (Figures 3-2 to 3-10). Four of the six FSCAs are located in the upper half of the lake, upstream from the town of Gifford. The FSCAs are numbered 1 through 6, with the first FSCA being the uppermost sampling area near the U.S.-Canadian border (see Figure 3-3). Five of the FSCAs correspond to sediment sampling focus areas.

3.1.3 Sample Timing

Fish will be collected during two collection periods, the first in September 2005 and the second in October 2005. Both collection periods are near the end of the growing season for fish in the UCR, and, therefore, captured fish will have had almost an entire season of feeding and growth before being analyzed for contaminants.

The September sampling period will primarily target lake whitefish, and the remaining species will be collected in October. October is approaching the fall spawning period of lake whitefish, and collection prior to spawning is important so that the fish will not have a chance to expel any accumulated contaminants through eggs. Sampling for lake whitefish in the middle and lower reservoir requires deep gill net sets that are unlikely to capture the other target species. At FSCAs 1 and 2, whitefish will be collected using electrofishing in littoral zones and gill nets set at shallower depths. These methods are likely to capture other target species in addition to lake whitefish, and these species will be collected and processed for tissue analyses.

During the October collection period, FSCAs 1 and 2 will be sampled first to complete the collection of any target species not completed during September while minimizing the time difference between collection of these species at these sites. Collection at the remaining FSCAs for all target species except lake whitefish is scheduled for mid- to late October.

3.1.4 Sample Types

Five replicate composite samples for each target species and tissue type will be collected within each of the six fish sampling areas (Table 3-1). At FSCAs 1, 3, and 6, both fillet and offal will be analyzed for walleye and rainbow trout and whole-body samples will be analyzed for all other species. At FSCAs 2, 4, and 5, whole-body samples will be analyzed for all species. Thus, a total of 180 composite samples are planned for collection (see Table 3-1). The inclusion of laboratory duplicates will result in a total of 198 composite samples to be analyzed.

The following tissue types will be analyzed for each target species:

- Walleye—fillet and offal at three sites and whole body at three sites
- Rainbow trout— fillet and offal at three sites and whole body at three sites
- Lake whitefish—whole body only
- Largescale sucker—whole body only
- Burbot—whole body only

Whole-body samples are being analyzed because tribal and potentially other ethnic population groups are known to consume more than just fillets. Analysis of whole fish will provide a conservative estimate for those groups. These tissue samples will also be used to assess risk to the fish and to the wildlife that may consume them.

Skin-on fillets will be analyzed because fillets are expected to be the common mode of preparation for the typical recreational angler. In addition, USEPA (2000c) recommends this tissue type for use when conducting fish tissue analysis for dioxins/furans and PCBs. Analyzing the offal (the portion of the fish remaining after fillets are removed) on the same samples from which the fillets are removed will provide an estimate of both fillet and whole-body concentrations for those samples, and will allow estimation of the ratio of fillet to whole-body contaminants for rainbow trout and walleye. The estimated whole body concentration will be the weighted average concentration of chemicals in the fillet and offal subsamples from a single composite sample. Rainbow trout and walleye have been selected for filleting because, of the five species to be collected, these are most frequently consumed by recreational anglers.

Individual species and tissue specific samples will consist of a composite of five individual fish of a similar size. At a minimum, three fish will be used only if availability warrants adjusting the sample size. The objective of selecting a compositing approach was to collect samples that are representative of the average tissue concentration over the sample area. A compositing approach allows for more individual fish to be analyzed, while controlling analytical costs. Increasing the number of individuals per composite sample within each sample area increases the representativeness of the estimate of the average tissue concentration for that sample area, and provides a estimate of long–term consumption exposures. Although a compositing approach to sampling precludes measurement of

contaminant concentrations in individual fish, the variance around the mean concentration for the population can be estimated if the number of fish per composite is the same in all composites and if fish are randomly assigned to composites at each collection area.

Compositing will be done using the following approach, which is consistent with the statistical assumptions used to design the study. A more detailed discussion of the statistical basis of the study design is provided in Appendix D.

Individuals of a given species collected from a given FSCA will be randomly assigned to one of the five composites planned for collection at each FSCA. Fish will be collected from three or more locations within the FSCA depending on habitat availability and optimal collection conditions. The individual fish collected within each FSCA will be pooled by species. All individuals retained will be within a size range that satisfies the QA requirements detailed in Section 3.4.1.2. Each fish will be assigned a unique sample number. A random number generator will be used to assign individuals of a given species to a sample composite at a give FSCA.

3.1.5 Target Analytes

The following analyses will be performed on the fish tissue samples (see Table 3-2):

- TAL metals
- Inorganic arsenic (20 percent of samples)
- PCB Aroclors
- PCB congeners
- Dioxin/furan congeners (octa- through tetra-)
- Percent lipids
- Percent moisture

All analytical data will be expressed as wet-weight concentrations. Metals will be analyzed in fish tissue because it is documented that large quantities of metals have been discharged into the UCR (see Fish Tissue A&R Document [CH2M HILL 2005b]), metals are elevated in the sediments of the UCR, and elevated metals have been found in fish from the UCR.

PCB congener analysis will be performed for as many congeners a practical by the analytical laboratory on 20 percent of the samples. These 20 percent will be composed of one of the five composite samples for each species at each FSCA. The remaining samples will be analyzed for the dioxin-like congeners on the World Health Organization (WHO) list and an additional select group of congeners that are most common in the first group of samples. Final decisions on the number of additional congeners to be analyzed will be made after review of the first set of analyses and consultation with the TOPO.

Because the current understanding of the adverse human health effects of arsenic is based primarily on epidemiological studies of people ingesting inorganic arsenic in drinking water, analytical methods that measure inorganic forms of arsenic as a portion of total arsenic are necessary. Generally, most of the arsenic in fish is the relatively nontoxic organo-arsenic form. Because of the expense of inorganic arsenic analysis, only a portion of samples from each site will be analyzed.

Dioxins and furans are proposed for analysis because past studies have documented their presence in both fish and suspended particulates. Although there are no identified sources, PCBs have been detected in fish in previous studies. The nature and extent of PCBs in sediments of the UCR is currently unknown. Past studies have analyzed for PCBs, but the detection limits were higher than the risk-based screening levels.

3.1.6 Sampling Contingencies

The fish sampling plan described in this document—including target species and lengths, composite sampling scheme, and collection areas—has been designed to meet the primary study objectives as effectively and efficiently as possible. It is expected that modifications to the plan will be necessary to account for complications resulting from weather, number and size of fish collected, optimal locations for collection of fish, and other factors.

All alternative approaches or potential modifications to the approach will be selected to first maximize the collection of the samples as specified. Only after all attempts have been made to complete the plan as designed will alternative approaches to the primary study design be implemented to collect samples.

Following is a sequence of possible complications and contingent alternative approaches to be taken after initial electrofishing transects, gill net sets, or trap deployments are completed. In general, the alternative approach will be to expand the sample area first, followed by expanding the targeted size range. Primary and secondary contingent approaches are listed.

1. Collection of one or more target species is difficult at initial sample locations selected within an FSCA.

   Primary: If other sample locations in the same FSCA are more productive, focus collection efforts on those locations to increase sample size to 25.

   Secondary: Identify additional sample locations and shift sampling effort to those locations to increase sample size to 25.

2. Collection of one or more target species is difficult at all locations within an FSCA (or one FSCA within a reach).

   Primary: If habitat characteristics appear favorable outside the designated FSCA, attempt to collect from those locations.

   Secondary: If habitat characteristics appear favorable at other FSCAs within the same reach, substitute collection from those locations.

3. Few fish collected for a species are within the target size range, but more are present outside the range.

   Primary: If most fish are either too large or too small, the target range may be missing a size or age class. Amending the target size range to first a larger size then a smaller size may be appropriate. If this occurs at the first site sampled, consider amending the size range for that species.

Secondary: If other sites have been completed using fish of the correct size range, make every effort to find species in the appropriate size range, including options listed in Item 2 above.

4. Collection of one or more target species is difficult at all FSCAs within a reach.

   Primary: Select alternative species, accepting that comparisons cannot be made among species. This situation is likely for lake whitefish in the upper reach of the UCR. Mountain whitefish may be substituted.

   Secondary: Drop the species/reach combination.

5. Few collections for a given species reach the target number of 25. The compositing scheme may be modified from the target number of five composites of five fish in each area. For example, if only 20 fish are collected at some sites, it may be determined that composites samples of four individuals should be used at all areas for that species.

6. For hatchery versus wild rainbow trout, contaminant accumulation may differ between rainbow trout of wild origin and those from hatcheries reared in net pens. However, it is difficult to predict the relative proportion of hatchery versus wild rainbow trout that will be collected in an area, and it may not be possible to distinguish between them with certainty. Therefore, composite samples of rainbow trout will be separated, if possible, into "hatchery," "wild," or "mixed" composite samples.

3.2 Sampling Methods (B2)

This section describes field methods and procedures to be used for Phase I fish tissue sampling, organized in accordance with USEPA guidelines. The field methods and procedures will consist of two separate activities: fish collection and onshore processing at the UCR site, followed by sample processing at an offsite laboratory. The offsite sample processing will be performed at the CH2M HILL laboratory in Corvallis, Oregon, in preparation for shipment of the samples to selected laboratories for chemical analysis. The offsite CH2M HILL laboratory activities will include filleting and homogenization of samples prior to chemical analysis.

3.2.1 Field Collection and Handling of Fish

The fish collection and onshore processing methods described in this section are intended to provide standardized, reliable, and repeatable results in an economical manner and were derived from USEPA (2000c).

3.2.1.1 Field Operations Schedule

Field mobilization for the work described in this QAPP is expected to begin in early September 2005. The sampling will be initiated in September and is scheduled to conclude near the end of October 2005, with an allowance for continuing the sampling into early November if necessary. A detailed field schedule is provided in Tables 3-3a and 3-3b for the September and October sampling stages, respectively. Generally, separate teams will be used for fish collection and for onshore processing, although some personnel will be involved in both efforts. The fish collection teams will use specially configured vessels to collect the targeted fish species. Sample processing teams will staff the processing station

located at a marina or other suitable location on a daily basis to handle processing and paperwork associated with the samples delivered each day from the collection teams.

The detailed schedule in Tables 3-3a and 3-3b will be used by the field team assigned to each vessel to establish the day's objectives. The detailed schedule will serve as a general guide and will be updated by the STL on a daily basis in order to manage the day-to-day variations in progress being made by the sampling teams and to manage the workload distribution.

Adjustments to specific dates may be necessary to account for variable conditions such as inclement weather, difficulties in accessing sampling locations, or time needed to collect samples. Modifications to the field operations schedule are expected and will be monitored by the PM and communicated to the TOPO on a regular basis. Changes in schedule will not be documented in the field change request form discussed in Section 4.1.

3.2.1.2 Sampling Location Selection Procedures and Identification

As stated in Section 3.1, there will be six FSCAs. The sampling locations within each FSCA will be pre-selected, if possible, based on information provided by various state, federal, or tribal organizations prior to the field sampling effort. This information may include specific sites sampled in previous studies, or areas known to these entities to contain preferred habitat for the target species. If no information is available regarding past sampling or any other specifics, the sampling locations in an FSCA will be selected while in the field based on depth, distance from shore, or other characteristics known to be preferred by the target species. If preferred habitat is widely distributed within an FSCA, attempts will be made to sample multiple dispersed locations within the FSCA, at least initially, to maximize the probability of obtaining the target sample sizes. Specific sampling locations may be moved or concentrated based on results of previous days' effort.

Global positioning system (GPS) coordinates will be recorded for the specific locations where each gill net or trap is deployed. For electrofishing transects, GPS coordinates will be recorded for the start and finish of each run. This information on the specific sampling locations (including depth) may be useful in adjusting sampling locations for better catch success. The sampled locations are not, however, intended to be "stations" within the larger FSCAs because they will not be used for analytical purposes. Composite samples of fish will be obtained from fish randomly selected (at the laboratory) from within each FSCA, not from specific locations within the FSCA.

3.2.1.3 Sampling Gear

Fish collection will be done by use of boat-mounted electrofishing, gill net sets, burbot traps, and angling, if necessary. Electrofishing will be conducted in littoral areas, using a voltage that will produce a direct current (DC) of approximately 5 amperes. Previous fish sampling in Lake Roosevelt indicates that, of the five target species, electrofishing will be the most effective method for capturing largescale sucker and rainbow trout, although some walleye will be captured as well.

Gill nets will be the primary capture method for lake whitefish, which are typically found in the deeper pelagic zones, and walleye, which are typically found near the bottom in moderately shallow water. Specific information for sampling depths in each FSCA will be

determined by individual field teams based on the characteristics (e.g., depth, temperature profile, distance to shore, fish finder data) at the sampling locations.

Gill nets with mesh sizes appropriate for the targeted size ranges will be used to the extent possible to avoid excessive sampling effort and minimize by-catch of smaller fish. The gill nets and supporting lines will be constructed of nontarred monofilament or twine to avoid contamination with petroleum-based compounds.

Burbot collection is expected to be most effective using species-specific traps, although some may be captured by electrofishing or gill netting as well.

Angling may be used to collect some fish species, particularly rainbow trout, if other methods of collection are not effective in obtaining the desired sample sizes. Angling success for rainbow trout is known to be good in Lake Roosevelt during November. Because the primary sampling period will occur prior to November, the use of angling for trout will be a reasonable contingency in the event sample sizes are not met earlier.

A list of equipment and supplies needed for onboard fish collection is provided in Table 3-4.

3.2.1.4 Fish Collection Procedures

Sampling Gear Operation

Each field sampling team will have the necessary knowledge and experience to perform all field activities. This will include experience in the collection of fish, the use of the specified sampling gear, and operation of small boats. All crew will be familiar with the sampling plan and will participate in site and equipment orientation.

In general, gill nets will be set in the afternoon and pulled the following day. Placement of gill nets at each site will be determined based on the targeted species and the site characteristics. If possible, fish will be removed from the nets as the nets are pulled into the boat, target species within the correct size range retained, and nontarget species and sizes released or disposed as specified by the collection permit. In some cases, depending on weather conditions or time constraints, the entire nets and captured fish will be placed into plastic containers for later sorting on the boat or onshore.

For electrofishing, fish collection will be done primarily at night when this method is usually most effective. However, daytime electrofishing may be necessary in some cases because of safety concerns or scheduling requirements. Stunned fish will be collected with long-handled dip nets and placed in species-specific tubs, coolers, or built-in containment wells for later sorting and identification. Attempts will be made to dip net only the targeted species of the desired size range.

Burbot will be sampled using species-specific traps set in moderately deep water and baited with fish. Because burbot are subject to injury and/or mortality resulting from gas bubble trauma when brought rapidly to the surface, steps will be taken to reduce gas bubble trauma and associated mortality for nontarget size ranges of this species. These steps may include deflation of the swim bladder and gut cavity using a needle immediately after capture, reducing handling time and rapidly returning nontarget individuals to deep water, and/or holding fish at moderate depth for at least several hours to allow the fish to acclimate to lower water pressure.

Angling for rainbow trout, if needed, will be performed using nonscented artificial lures on braided or monofilament line. Specific procedures for locating and angling for rainbow trout will be determined in consultation with local biologists or fishing guides. An FTL will be onboard each fishing vessel to collect and handle the fish according to protocol.

Crew members will wear nitrile gloves when handling the fish. Special care will be taken to ensure that petroleum products such as grease or fuel do not come in contact with surfaces that contact the fish.

The selected length (total) ranges for each target species to be collected are as follows:

- Walleye—33 to 43 centimeters (cm) (13 to 17 inches)
- Rainbow trout—33 to 43 cm (13 to 17 inches)
- Largescale sucker—33 to 43 cm (13 to 17 inches)
- Lake whitefish—33 to 43 cm (13 to 17 inches)
- Burbot—43 to 56 cm (17 to 22 inches)

Following is an overview of the fish collection procedures:

1. Transport sample equipment and samplers by boat to the FSCA
2. Deploy and retrieve sampling gear
3. Transfer fish from sampling gear to appropriate holding containers
4. Prepare field sampling records
5. Decontaminate sampling equipment
6. Transfer samples to the onshore fish sample processing station
7. Weigh, measure, and examine individual fish
8. Package and label samples
9. Complete field documentation
10. Ship samples to the offsite processing laboratory

Detailed descriptions of daily sampling team operations are provided in Standards of Practice (SOPs) FISHQAPP-1 and -2 in Appendix C for the September and October sampling stages, respectively.

Sample Acceptability and Field Quality Assurance

All fish captured will be inspected for damage. Fish that show physical damage from the capture method, such as bleeding or severe abrasions or cuts, will not be kept.

Sample Handling

All fish kept for processing will be euthanized using a sharp blow to the head with a foil-wrapped or decontaminated mallet or club, being careful not to break the skin of the fish. Each selected fish will be tagged on the boat with a waterproof tag, which will be physically attached to the fish with a cable tie. A sequential 4-digit numerical coding system will used (e.g., 0001, 0002, 0003... 1999). The initial numeric code will be 0001. The project name will also be included on the label.

The tagged fish will be placed in coolers and on ice during transport to the onshore sample processing location. The coolers will be labeled with species, FSCA sample location, and date.

Field Measurements (Onshore)

Following receipt of the fish from the field collection crew, the onshore sample processing team will weigh, measure, and examine each fish in accordance with SOP FISHQAPP-3 provided in Appendix C. Fish length will be measured as total length, defined as the distance from tip of the tail to the tip of the nose. For any fish that does not fit on the measuring board, a standard measuring tape will be used. All length measurements will be recorded to the nearest millimeter (mm). Individual fish will be weighed with a digital scale and weight will be recorded to the nearest gram.

After fish have been measured, an external examination will be conducted to document the presence of external anomalies. The external examination will generally follow the Biomonitoring of Environmental Status and Trends (BEST) guidelines (USGS 2004), which are based upon methods developed by Goede (1993) and Adams et al. (1993). The UCR examination will document external features only, for future reference purposes, and possible correlation to the results of the contaminant analyses. The planned observations are not intended to derive statistical relationships between abnormalities and tissue contaminants, only to permit some inference with respect to fish health and condition.

Table 3-5 is a tabular list of the condition indices with descriptions for each of the assessed external features to be documented on the external examination form provided in Appendix B. External features that will be examined include eyes, skin, fins, parasites, gills, pseudobranchs, thymus, and opercles. Attention will be paid to whether the collection of the fish (i.e., electrofishing, gill netting, or trapping) may have induced some of the anomalies. In addition, if the fish has been dead for a prolonged period of time (i.e., gill net capture), certain external features may appear to have anomalies (i.e., pale gills), and these observations will be documented accordingly on the external examination form.

Following external examination, the identified samples will be prepared as described in Section 3.3.1.2 for shipment to the offsite processing laboratory.

3.2.2 Equipment Decontamination Procedures

The field team will decontaminate all onboard sampling equipment that comes into contact with either fish or bottom sediments prior to the commencement of sampling at each location and upon completion of the study. This will include equipment such as gill nets, dip nets, temporary fish-holding containers, and gloves used for electrofishing (i.e., electrician's gloves). The decontamination will consist of thoroughly rinsing all of the equipment with lake water away from the shoreline and any areas where sediment has been disturbed, such as in a location where gill nets and their anchors where removed. Field equipment used for measuring and weighing the fish at the onshore processing stations will be rinsed with lake water at the boat launches after each use. This will include the digital scale pans, the fish measuring boards, and the holding containers in which the fish were stored and transported.

Nitrile gloves used for handling fish in the field and onshore will be discarded, not decontaminated. Clean gloves will be worn at each sampling location to avoid transfer of potential contaminants among samples.

3.2.3 Containment and Disposal of Investigation-Derived Waste

All disposable materials used for catching, transporting, and processing fish will be placed in heavyweight garbage bags or other appropriate containers and placed in refuse containers by field team members. Disposable materials include paper and cloth towels, nitrile gloves, and any plastic bags or other disposal containers that temporarily held fish during transport or processing.

3.3 Sample Handling and Custody (B3)

This section describes procedures for handling, preserving, and shipping samples to the offsite processing laboratory. Planning and documentation of all activities are emphasized to ensure that sample identity and integrity are preserved during all stages of the field operation. The offsite processing laboratory will prepare tissue homogenates from whole fish and then ship the homogenates to the selected laboratories for analysis.

3.3.1 Sample Management Tools

Thorough documentation of all fish collection and handling activities is necessary for proper processing in the laboratory and, ultimately, for interpretation of analytical results. Sample management will consist of assigning a unique alphanumeric code to each sample and using the following forms and labels:

- A field record form that contains information about each fish and sampling area
- A sample identification label that accompanies and identifies each individual fish
- A chain-of-custody form that provides continuous tracking information for all samples
- A chain-of-custody label that seals each shipping container

The sample coding scheme, forms, and labels that will be used are described in the subsections below.

As directed by USEPA, FORMS II Lite™ software will be used to facilitate management of the fish samples. FORMS II Lite™ is a Windows-based application package that was developed by USEPA for use as a sample management and tracking tool. Contractors performing analyses within the USEPA CLP are required to use this software. FORMS II Lite™ simplifies and accelerates the sample documentation process by providing the following:

- Automated printing of sample documentation in the field
- Reduced time spent completing sample collection and chain-of-custody forms
- Electronic capture and transfer of data before and during sampling activities
- Improved data integrity by automating data transfer

Forms II Lite™ will be used to generate sample labels and chain-of-custody forms and to communicate sampling progress to USEPA and other members of the project team. An example Forms II Lite™ chain-of-custody form is provided in Appendix B.

3.3.1.1 Sample Labeling

As described in Section 3.2.1.4 under "Sample Handling," the following information will be hand-written on the sample label at the time of collection with an indelible marker:

- Project name
- Fish field tag number

If necessary, corrections will be made on the sample labels by drawing a single line through the error and entering the correct information with an indelible marker. All corrections will be initialed and dated by the person performing the correction. If possible, the individual who made the error will correct it.

The sample labels will be plastic cable ties attached to the fish through the mouth and gill opening. When the individual fish are wrapped for shipment, this sample label will remain attached to the specimen. Sample packaging is discussed in the following section.

3.3.1.2 Sample Packaging and Shipping

After completing each day of sampling, the sampling vessel will return to the boat launch and the field crew will deliver the fish samples, held in coolers with ice, to the onshore sample processing team. The onshore processing team will have at their disposal a secure area for temporary storage (i.e., a freezer or refrigerated truck capable of sub-zero temperatures) and packaging where the fish samples will be prepared for shipment to the processing laboratory. Sample packing materials and preservation methods are discussed in Table 3-6.

At the onshore sample processing facility, the following procedure will be employed:

1. Leave the original sample label attached to the fish.
2. Weigh, measure, and examine each fish, as described in Section 3.2.1.4. Fish should be handled using nitrile gloves, which will be replaced between fish from different FSCA and sampling locations.
3. Wrap individual fish in heavy-duty aluminum foil, shiny side out.
4. Place each foil-wrapped fish into a section of heavy-duty, food-grade, polyethylene tubing that will be cut to size to fit the specimen, and seal the ends of the tubing with plastic cable ties.
5. A secondary field tag will be placed on each fish to facilitate identification and sample organization at the homogenization laboratory without unwrapping the fish. The secondary tag will indicate the fish species, FSCA, and the field tag number. For example, FSCA 6—Lake Whitefish—0001.
6. Place wrapped fish inside a large, clear plastic bag with the other wrapped fish of the same species collected from the same location and seal with a plastic cable tie.

Once the samples are packaged, the onsite SPC will have one of two shipping options:

- Ship the samples packed on dry ice (in sufficient quantity to keep the samples frozen for up to 48 hours), via priority overnight delivery service, so that they arrive at the processing laboratory within 48 hours from the time of sample collection, OR

- Freeze the samples in a secure freezer maintained at the onshore sample processing facility within 24 hours of collection and store the frozen samples until shipment within approximately 1 week of sample collection. The frozen samples will be subsequently packed on dry ice and shipped to the processing laboratory via priority overnight delivery service to arrive within 24 hours from the time of shipment.

The second option will be preferable when all fish needed from a collection area cannot be collected on the same day, and/or if too few fish are collected on a given day to comprise a shipment, or if other limitations (e.g. available personnel or remote location) make daily shipments inefficient. In such a case, the available fish will be wrapped and labeled as described above and maintained under custody in an onsite freezer at the sample processing facility.

Sturdy plastic coolers will be used as shipping containers. Enough fish will be placed in each cooler to occupy 60 to 70 percent of the cooler volume, and the remaining space in the cooler will be filled with dry ice. A completed chain-of custody form and copies of the field record forms for the samples will be included in each cooler. Both forms are described in Section 2.6.2.

After each cooler is packed with fish samples and dry ice, it will be secured at both ends with nylon strapping tape and the following items will be attached:

- Address label for processing laboratory
- Two custody seals
- Overnight shipping airbill
- Perishable goods label
- Class 9 Dangerous Goods Label (required by U.S. Department of Transportation (DOT) for coolers containing dry ice that will be shipped by air)

When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler).

3.3.2 Field Notebooks

The information to be entered in the field notebook is described in Section 2.6, and the information to be entered in laboratory notebooks is described in the FSP Section 2.6. In addition to chain-of-custody records, a bound field notebook will be maintained by each sampling FTL to provide a daily record of significant events, observations, and measurements during field investigations. All entries will be signed and dated. The notebook will be kept as a permanent record.

These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings.

3.3.3 Corrections to Documentation

All original data recorded in field notebooks, sample identification tags, chain-of-custody records, and receipts-for-sample forms will be written with waterproof ink, unless prohibited by weather conditions. None of these accountable serialized documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to one team, the FTL may make corrections simply by drawing a single line through the error and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on an accountable document should be corrected by the person who made the entry. All subsequent corrections must be initialed and dated.

3.4 Analytical Methods (B4)

This section discusses the methods for the offsite fish processing laboratory and for the chemical analyses to be performed at the CLP, MEL, and contract laboratories.

3.4.1 Offsite Fish Processing Methods

Fish will be shipped from the field to the offsite processing laboratory. The processing laboratory will remove the otoliths (Note: Opercles instead of otoliths will be removed from largescale suckers.) and prepare homogenized tissue samples from whole fish, fillets, or offal, and then ship the samples to analytical laboratories for chemical analysis. This section describes the procedures that will be followed for these activities, and SOP SVO 39.01 in Appendix C provides further details.

3.4.1.1 Sample Containers and Preservatives

USEPA (2000c) describes container materials that are suitable for storing homogenized fish tissue samples (see Table 3-6). Borosilicate glass, quartz, and polytetrafluoroethylene (PTFE, or Teflon) are suitable materials for the suite of target analytes for this study (mercury, other metals, organics, and lipids). Pre-cleaned and certified glass jars with Teflon-lined lids will be used if possible. USEPA (2000c) recommends that homogenized fish tissue samples be stored frozen at –20 degrees Celsius (°C) or lower. This recommendation will be followed for this investigation. The maximum holding time for a sample depends on the target analyte, as shown in Table 3-6. Holding times specified in Table 3-6 will also apply to any sample aliquots archived for future analysis.

3.4.1.2 Sample Processing Procedures

This section describes the procedures and equipment that will be used to create composite fillet samples and composite whole-body samples from whole fish.

Operations Schedule and Personnel

The personnel performing the processing will be trained or supervised by an experienced fisheries biologist. The work will be conducted in a timely manner so that subsequent analytical work can be completed within the maximum holding times listed in Table 3-6.

Processing Equipment

Care will be taken to prevent cross-contamination of samples. To assist in controlling potential cross-contamination, separate sets of utensils and cutting boards will be used for scaling fish and for filleting fish. For scaling, clean glass or Teflon cutting boards, or ones that have been wrapped in fresh aluminum foil (dull side out), will be used. Scales will be removed with a clean stainless steel, ceramic, or titanium knife. For filleting, a separate set of the same equipment needed for scaling will be used. In addition, contaminant-free, deionized water will be used for cleaning the fish fillets in the event that the fish is frozen before resectioning, which may cause internal organs to rupture, or if an organ is inadvertently severed during filleting. Equipment that will be used to homogenize samples includes pre-cleaned glass homogenization containers, an automatic grinder (a high speed blender or homogenizer is sufficient), aliquot containers (pre-cleaned glass jar with Teflon-lined lid), freezer capable of storing all samples at less than –20 °C, and dry ice to chill homogenization equipment. Table 3-7 provides a complete list of equipment needed for sample processing.

Processing Procedures

All otolith removal, filleting, and homogenization of fish samples will be conducted in the offsite processing laboratory, not in the field. As described in Sections 3.3.1.2, samples will be shipped from the onshore processing station to the offsite processing laboratory within 24 hours of collection for next-day delivery, or stored frozen at a secure facility in the field and shipped to the offsite processing laboratory within approximately 1 week of collection. Processing procedures in the offsite laboratory will follow the general guidance in USEPA (2000c).

Filleting Procedures

Filleting will follow general guidelines in USEPA (2000c). On the day before filleting and homogenizing, the frozen whole fish scheduled to be processed will be moved into a refrigerator (4 ± 2 °C) and allowed to partially thaw overnight. Following this procedure, fish will not be allowed to thaw completely, but to the point where it becomes possible to make an incision into the flesh. Fish targeted for filleting will be scaled prior to the actual filleting process.

The following filleting procedure will be used:

1. Prior to filleting, hands will be washed with Ivory soap and rinsed thoroughly in tap water, followed by contaminant-free, deionized water, or a clean pair of nitrile gloves will be worn.

2. All cutting boards and utensils will be cleaned prior to use by washing with laboratory detergent and water, three times with de-ionized water, three times with pesticide-grade methanol, and three times with methylene chloride and allowed to air dry before use.

3. Care will be taken to ensure that specimens come into contact only with decontaminated cutting boards and utensils

4. Individual fish will be placed on decontaminated glass or Teflon cutting board or on one that has been covered with clean heavy-duty aluminum foil. Otoliths will be removed using a clean, high-quality stainless steel, ceramic, or titanium utensil. Care will be taken

to avoid any loss of tissue or liquid during otolith removal. Otoliths will be placed in containers specified by the laboratory that will prepare and read the otoliths.

5. If necessary for homogenization, scales will be removed using a clean stainless steel, ceramic, or titanium knife. Scales and adhering slime will be removed by using the blade edge of a clean stainless steel, ceramic, or titanium knife and scraping from the tail to the head.

6. A clean, high-quality stainless steel, ceramic, or titanium utensil will be used to remove both fillets. The belly flap will be included in each fillet.

7. Any bones still present in the tissue after filleting will be carefully removed.

8. Any dark muscle tissue in the vicinity of the lateral line will not be separated from the light muscle tissue that constitutes the rest of the muscle tissue mass. Both fillets from each fish will be removed and combined for the composite sample.

9. Homogenized fillets and offal will be weighed to the nearest gram and recorded on the FPF—see Section 2.6.3 and Appendix B.

10. All cutting boards and utensils will be cleaned between samples with detergent and with trace-metal-free and organics-free deionized water, followed by solvent rinses between samples.

11. If an aluminum-foil-covered cutting board is used, the foil will be changed between fish.

Care will also be taken to avoid contaminating fillet tissues with material released by the inadvertent puncture of internal organs. If the fillet is inadvertently contaminated, the fillet tissue will be rinsed in contaminant-free, deionized distilled water and blotted dry with noncontaminating materials. In addition, documentation of the contamination will be completed on the FPF.

Fillet and offal samples will be homogenized individually. Initially, fish fillets will be ground or homogenized using a blender or commercial food grinder. Large fillets may be cut into small cubes with high-quality stainless steel or titanium knives to ease homogenization. Because the grinding and homogenization of fish tissue is easier when the tissue is partially frozen, the grinder will be chilled by grinding with a few chips of dry ice before processing each sample.

The fillet sample will be ground until it appears to be homogenous on visual inspection, then transferred to a clean (detergent, deionized water, solvent-rinsed) stainless steel mixing bowl. The ground sample will then be divided into quarters, opposite quarters will be mixed together using a solvent-rinsed spoon or spatula, and the two halves mixed back together. The grinding, quartering, and hand mixing will be repeated two more times. If chunks of tissue larger than 1 mm are observed to be present at this point, the grinding/homogenizing will be repeated.

Compositing Procedures

Composite fish samples will be analyzed for Phase I of the UCR Site RI/FS because it is more cost-effective than analyzing individual fish. In addition, composite samples provide a more accurate depiction of average contaminant levels than a similar number of individual

samples. If practical for rainbow trout, specimens of hatchery and wild fish stocks will be identified and will be composited and analyzed separately, because sources and concentrations of contaminants may differ between the two types of stocks.

Fillet and Offal Composite Samples (Walleye and Rainbow Trout). Composite homogenates for the fillet samples will be prepared from equal weights of individual homogenates. The same type of individual homogenate (i.e., either single fillet or combined fillet) will always be used in a given composite sample. Once individual homogenization is complete, equal weights from the individual homogenates will be combined to form a minimum 200-gram composite sample. If individual homogenates are frozen before composite preparation, they will be thawed partially and rehomogenized prior to weighing and compositing. Any associated liquid will be kept as a part of the sample. The weight of each individual homogenate used in the composite homogenate will be recorded, to the nearest gram, on the FPF.

The composite sample of the individual homogenates will be combined following the mixing procedure described above (see last paragraph under Filleting Procedures, above). At this time, the composite homogenate will be separated into sample aliquots for analyses. The composite homogenate may be frozen and stored at less than -20 °C in pre-cleaned glass containers with Teflon-lined lids before preparing aliquots. If the composite homogenates are frozen before aliquot preparation, samples will be rehomogenized before aliquotting for analyses.

The remainder of each individual homogenate (up to 250 grams) will be archived at less than -20 °C with the designation "Archive" and the expiration date (based on the holding times in Table 3-6) recorded on the sample label. The location of the archived samples will be indicated on the appropriate chain-of-custody form.

Whole-Body Composite Samples (All Target Species). Whole-body composite samples will be homogenized individually following removal of the otoliths from each individual (otoliths will be removed in the same manner as described in the filleting procedure above). Equal weights of each individual homogenate will be combined to form a composite of 200 grams combined weight. Smaller whole fish (0 to 1,000 grams) will be ground in a commercial meat grinder or blender equipped with stainless steel blades before homogenizing. Larger fish (>1,000 grams) will be cut into small pieces with a stainless steel knife or cleaver and then ground in the blender or grinder. All parts of the grinder or blender that come into contact with the sample will be cleaned prior to use by washing with laboratory detergent and water, three times with de-ionized water, three times with pesticide grade methanol, and three times with methylene chloride, then allowed to air dry before use.

Because the grinding and homogenization of fish tissue is easier when the tissue is partially frozen, the grinder will be chilled by grinding with a few chips of dry ice prior to fish grinding.

The ground sample will be transferred to a clean (detergent, deionized water, solvent rinsed) mixing bowl and divided into quarters. The opposite quarters will be mixed together by using a solvent-rinsed spoon or spatula, and the two halves mixed back together. Grinding, quartering, and mixing will be repeated two more times. If chunks of

tissue larger than 1 mm are observed, grinding/homogenizing will be repeated. At this time, depending upon aliquot preparation timing, individual whole fish homogenates may be either subsampled to form the 200-gram composite sample, or frozen and stored at less than –20 °C in pre-cleaned and certified glass containers before creating the 200-gram composite sample. If the composite homogenates are frozen before aliquot preparation, samples will be rehomogenized before aliquotting for analyses. The remainders of each individual homogenate (up to 250 grams) will be archived at less than –20 °C with the designation "Archive" and the expiration date (based on holding times in Table 3-6) recorded on the sample label.

Composite Sample Coding Scheme

Composites samples will be formed after individual fish have been shipped to the offsite processing facility. A unique, 6-character, alphanumeric code (i.e., composite sample identification code) will be assigned to each composite sample. The code will include the following information:

- Fish species (characters 1 and 2):

  WE = walleye
  RH = rainbow trout (hatchery)
  RW = rainbow trout (wild)
  RM = rainbow trout (mixed wild and hatchery)
  LW = lake whitefish
  LS = largescale sucker
  BB = burbot

- Sampling area (character 3): 1 through 6
- Whole body, fillet, or offal composite sample (character 4): W = whole body (all target species); F = fillet (only RT and WA); O = offal (only RT and WA).
- Replicate number (character 5): 1 through 5.
- Number of specimens in composite sample (character 6): e.g., 5, 4, 3

For example, **WE3F25** is the code for the second composite walleye sample for fillet and offal analysis from area 3; the sample contains five fish. Composite samples of rainbow trout and walleye fillet and offal will be composed of the same five individuals.

Composite Sample Acceptability and Quality Assurance

Field QA procedures will be followed to ensure the quality of the data collected. Composite sample acceptability requirements stipulate that individual fish for a composite sample are of similar size, and that the smallest individual in a composite is no less than 75 percent of the total length (size) of the largest individual in the same composite. Further, USEPA guidance (USEPA 2000c) suggests that the relative difference between the average length of individuals within any composite sample and the average length of all individuals in all composite samples should not exceed 10 percent. However, because of practical limitations for some species (such as low numbers of fish and/or high variability of sizes of fish), occasional deviations from these guidelines could occur.

QA procedures will be followed in the fish processing and composite preparation task through recordkeeping and documenting procedures for processing of all individuals and composites. Specific measures will include maintaining laboratory logs and datasheets, use of standard data collection forms (i.e., the FPF), and developing routine procedures, as discussed in this document, to assess the accuracy and completeness of records.

Sample Handling and Preservation

The composite tissue samples will be stored according to the methods listed in Table 3-6. Chain-of-custody procedures will be followed when the samples are shipped from the processing laboratory to other laboratories for chemical analysis. Sturdy shipping coolers with dry ice will be used for overnight shipping.

3.4.1.2 Equipment Decontamination Procedures

The composite tissue samples for this study will be analyzed for both organics and metals, including mercury. Prior to preparing each composite sample, utensils and containers will be cleaned thoroughly with a detergent solution; rinsed with tap water; rinsed with 1+4 trace metal grade nitric acid (HNO_3) and with trace-metal-free and organics-free deionized water, and solvent rinsed with methanol and methylene chloride. Stainless steel parts will be cleaned using this procedure, but without the acid rinse (USEPA 2000c).

3.4.1.3 Containment and Disposal of Investigation-Derived Waste

Waste materials generated during preparation of the fish tissue homogenates will be disposed of according to the standard operating procedures of the offsite processing laboratory.

3.4.1.4 Sample Handling and Custody

Sample Labeling

FORMS II Lite™ will be used to print new self-adhesive labels that can be attached to the sample containers for the homogenized fish samples. The new labels will contain the same information found on the individual-fish sample labels and composite fish sample labels discussed in Section 3.4.1.2. If necessary, corrections will be made on the self-adhesive labels by drawing a single line through the error and entering the correct information. All corrections will be initialed and dated by the person making the correction. If possible, the person who made the error will correct it.

Sample Packaging and Shipment

Sturdy plastic coolers will be used as shipping containers for the homogenized fish samples. Coolers will be filled only to approximately 70 percent capacity with sample containers, and the remaining space in the cooler will be filled with dry ice. A completed chain-of-custody form will be included in each cooler.

After each cooler is packed with sample containers and dry ice, it will be secured at both ends with nylon strapping tape and the following items will be attached:

- Address label for analytical laboratory
- Two custody seals
- Overnight shipping airbill
- Perishable goods label

- Class 9 Dangerous Goods Label (required by DOT for coolers containing dry ice that will be shipped by aircraft)

The processing laboratory will make every effort to ship samples as scheduled with the analytical laboratories.

3.4.2 Analytical Laboratory Methods

Project analytes, methods, and required detection levels are listed in Tables 2-3 to 2-5. The analyses for TAL metals, PCBs as Aroclors, PCBs as congeners, and dioxins and furans (tetra through octa congeners) will be performed in accordance with CLP methodology and through CLP laboratories or in accordance with MEL standard operating procedures. The analyses will be subject to QC requirements specified in Section 3.5 and Table 2-5.

For fish analyses, the analytical/laboratory reporting limits are laboratory specific. The laboratories will target the needed levels shown in Table 2-3and will report detection levels on a sample/analyte-specific basis. The selected methods are state of the art and what is practicable for this study. For reporting limits that are above the levels in Table 2-3 the project team may use the laboratory-specific MDLs, which are expected to be significantly lower than the reporting levels.

3.5 Quality Control (B5)

QC requirements are detailed in the following subsections.

3.5.1 Field Quality Control Procedures

QC requirements related to the sample collection process (that is, sampling design, sampling methods, sample handling, and sample custody) are described in Sections 3.1 to 3.3.

The design of the Phase I fish sampling includes, for all target species at six sampling areas, collection of five composite samples of five individuals each for whole-body analysis and/or fillet and offal analysis. Because composite samples are being collected, adequate sample mass will be available for the analytical laboratory to conduct matrix spike/matrix spike duplicate (MS/MSD) analyses. Therefore, collection of additional fish for this purpose will not be necessary.

3.5.2 Laboratory Procedures

Laboratory QC procedures will include the following:

- Analytical methodology and QC according to methods listed in Table 2-5
- Instrument calibrations and standards as defined in the methods listed in Table 2-5
- Laboratory blank measurements at a minimum 5 percent or 1-per-batch frequency
- Accuracy and precision measurements at a minimum of 1 in 20, 1 per set (MS and MSD will not be analyzed for dioxins and furans or congener analyses)

- Performance evaluation (PE) using a National Institute of Standards and Technology (NIST) tissue matrix SRM, purchased and sent to the laboratory for analysis
- Data reduction and reporting according to the methods listed in Table 2-5
- Laboratory documentation equivalent to the CLP SOW
- Homogenization proof blanks submitted at a rate of 1 per week

QC samples will be prepared to assist in assessing data quality. The QC samples included replicates of laboratory homogenates as well as analytical QC samples. Because the sampling design involves collection of five replicate composite samples at each FSCA for each target species, collection of additional field samples for QC purposes is unnecessary.

3.5.2.1 Laboratory Homogenate Replicates

One well-homogenized composite sample for each tissue type from each species (a total of 18 duplicate samples) will be used to produce triplicate samples for quality assurance of the homogenization. If insufficient tissue is available for triplicate samples from some tissue types (e.g., fillets) or species, duplicate samples may be produced from two composites. The replicate samples will be sent (blind) to all laboratories conducting analyses. These replicates primarily provide information about the uniformity of the homogenization procedure, but also provide information about the precision of the analysis.

3.5.2.2 Analytical Quality Control Samples

The laboratories that analyze the samples will evaluate analytical accuracy by conducting MS/MSD analyses on approximately 10 percent of the samples and by analyzing certified reference materials. In addition, the laboratory will analyze reagent blanks to assess the magnitude of any incidental contamination that potentially may bias the results.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance (B6)

Instrument maintenance logbooks are maintained in laboratories at all times. The logbooks, in general, contain a schedule of maintenance as well as a complete history of past maintenance, both routine and nonroutine.

Preventive maintenance is performed according to the procedures described in the manufacturer's instrument manuals, including lubrication, source cleaning, detector cleaning, and the frequency of such maintenance. Chromatographic carrier gas-purification traps, injector liners, and injector septa are cleaned or replaced on a regular basis. Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to degrade as evidenced by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or fail to meet one or another of the QC criteria.

Instrument downtime is minimized by keeping adequate supplies of all expendable items, where expendable means an expected lifetime of less than 1 year. These items include gas tanks, gasoline filters, syringes, septa, gas chromatography (GC) columns and packing,

ferrules, printer paper and ribbons, pump oil, jet separators, open-split interfaces, and mass spectroscopy filaments.

Preventive maintenance for field equipment (for example, pH meter) will be carried out in accordance with procedures and schedules outlined in the particular model's operation and maintenance handbook.

3.7 Instrument/Equipment Calibration and Frequency (B7)

3.7.1 Field Calibration Procedures

Field measurements included in the fish tissue sampling events will be limited to general water depth. Depth will be measured using meters onboard the boats, but calibration of these meters will not be performed because the depth measurements will be used only to assist the boat crew in locating suitable habitat for target species. Depth data will not be used as part of the human health or ecological risk assessment.

The balance or balances used to weigh the fish at the onshore processing station will be calibrated before the start of work and at the end of the sampling day. Any instrument "drift" from prior calibration should be recorded in a field notebook. Calibration will be in accordance with procedures and schedules outlined in the particular instrument's operations and maintenance manual.

Calibrated equipment will be uniquely identified either by using the manufacturer's serial number or by other means. A label with the identification number and the date when the next calibration is due will be physically attached to the equipment. If this is not possible, records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

Scheduled periodic calibration of testing equipment does not relieve field personnel of the responsibility for employing properly functioning equipment. If an individual suspects an equipment malfunction, the device must be removed from service and tagged so that it is not inadvertently used, and the appropriate personnel notified so that a re-calibration can be performed or a substitute piece of equipment can be obtained.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily re-calibrated. Equipment that cannot be repaired will be replaced.

Results of activities performed using equipment that has failed re-calibration will be evaluated. If the activity results are adversely affected, the results of the evaluation will be documented and the PM and (data users) will be notified.

3.7.2 Laboratory Calibration Procedures

Laboratory calibration procedures are specified in the methods referenced in Table 2-5. All calibrations, at a minimum, will be at the following level of effort:

- Initial calibration for all methods, where applicable, will include, at a minimum, three-point calibration before a run.
- Continuing calibration for all methods will include a mid-range calibration standard after every tenth sample or every 12 hours.

3.8 Inspection/Acceptance of Supplies and Consumables (B8)

Supplies and consumables will be acquired in accordance with FAR and inspected in accordance with acquisition specifications upon receipt. All sample containers used or purchased in this project to store homogenized tissues will be certified to meet USEPA specifications and guidance for contaminant-free sample containers.

3.9 Nondirect Measurements (B9)

This section describes data that were obtained from nondirect measurement sources such as computer data bases, programs, literature files, and historical data bases and that may be used in making decisions about conditions in UCR fish tissue. As part of planning for the RI/FS, historical data pertinent to the UCR RI/FS were identified and compiled into a historical database. The data were then reviewed to determine whether they were of sufficient quality for use in certain evaluations. This process is summarized in the following steps:

1. Potential sources of data and reports were identified by interviewing USEPA staff, reviewing existing USEPA preliminary assessment (PA) and ESI documents, contacting other governmental agencies and stakeholders, and searching the Internet. A standardized letter requesting information was then sent to identified sources. Effort was made to gather data and reports in electronic format. This process was documented in *Document and Data Gathering Task Summary* (CH2M HILL 2004a)
2. Once gathered, the data were assessed for quality and categorized according to usability, as documented in *Assessment of Quality and Usability of Analytical Electronic Data* (CH2M HILL 2005a).
3. Following assessment or simultaneously with the assessment, the data and reports were entered into a Site Information Management System (SIMS). The SIMS contains an internet accessible database linked to a geographic information system (GIS) to facilitate managing data based on location—an important feature for a site the size of the UCR. It allows access to site data and reports by anyone with Internet connectivity and appropriate authorization. Electronic copies of the various historical reports were entered into the SIMS document database.

3.10 Data Management (B10)

Data obtained during the Phase I sampling program will be managed according to the processes described in the project-specific data management plan prepared for the UCR site (CH2M HILL 2004b). All data for all parameters will undergo two levels of review and validation: (1) at the laboratory and (2) outside the laboratory, as described in Section 5.

Following receipt of validated data, they will be input into the SIMS to facilitate database queries and report preparation. The data will be stored in SIMS with all laboratory qualifiers included. Laboratory data from ASCII or equivalent files, provided by USEPA's QAO, will be adapted to files compatible with the project database, as described in the project-specific data management plan. The SIMS database will be maintained in a manner that is compatible with, and provided to, USEPA or others at USEPA's request. The data management process is depicted in Figure 2-2.

TABLE 3-1
Proposed Fish Sampling Locations
Upper Columbia River RI/FS

River Reach	Sample Location (FSCA)	River Miles	Number of Composite Samples									
			Walleye			Rainbow Trout[c]			Lake Whitefish	Large-scale Sucker	Burbot	
			Whole Body	Fillet[b]	Offal[b]	Whole Body	Fillet[b]	Offal[b]	Whole Body	Whole Body	Whole Body	Total
Upper	1[a]	742-740	0	5[d]	5[d]	0	5[d]	5[d]	5[d]	5[d]	5[d]	35
Upper	2[a]	724-722	5[d]	0	0	5[d]	0	0	5	5	5	25
Middle	3[a]	707-705	0	5	5	0	5	5	5	5	5	35
Middle	4[a]	679-677	5	0	0	5	0	0	5	5	5	25
Lower	5	636-634	5	0	0	5	0	0	5	5	5	25
Lower	6[a]	606-604	0	5	5	0	5	5	5	5	5	35
Laboratory replicates[d]			2	2	2	2	2	2	2	2	2	18
Total			17	17	17	17	17	17	32	32	32	198

[a] FSCA falls within sediment sample focus area.

[b] Fillet and offal will be taken from the same five individuals for each composite.

[c] For rainbow trout, composites will be noted as composed of wild, hatchery, or mixed-origin individuals.

[d] Three laboratory replicate samples will be formed from one composite sample at the indicated FSCA.

TABLE 3-2
Types of Analysis by Fish Species and Tissue Type
Upper Columbia River RI/FS

	Analyte						
Target Species	**TAL Metals**	**Inorganic Arsenic [a]**	**PCB Aroclors**	**PCB Congeners[b]**	**Dioxin/Furan Congeners**	**Percent Lipids**	**Percent Moisture**
Walleye							
Fillet	17	5	17	17	17	17	17
Offal	17	5	17	17	17	17	17
Whole Body	17	5	17	17	17	17	17
Rainbow Trout							
Fillet	17	5	17	17	17	17	17
Offal	17	5	17	17	17	17	17
Whole Body	17	5	17	17	17	17	17
Lake Whitefish							
Whole Body	32	5	32	32	32	32	32
Largescale Sucker							
Whole Body	32	5	32	32	32	32	32
Burbot							
Whole Body	32	5	32	32	32	32	32
Total	198	45	198	198	198	198	198

[a] Inorganic arsenic will be analyzed on approximately 20 percent of the samples to estimate a ratio of inorganic to organic arsenic.

[b] Initially, PCB congener analysis will be performed for as many congeners a practical by the analytical laboratory on 20 percent of the samples (i.e., 40 of 198 composite samples). The 20 percent will be composed of one of the five composite samples for each species at each FSCA. The remaining samples will be analyzed for the dioxin-like congeners on the WHO list and an additional select group of congeners that are most common in the first group of samples. Final decisions on the number of additional congeners to be analyzed will be made after review of the first set of analyses.

Note: The number of analyses listed for each sample type includes a triplicate laboratory homogenization sample for each tissue type.

TABLE 3-3a
Detailed Field Schedule, Stage 1
Upper Columbia River RI/FS

WEEK 1

		August			September			
		29	30	31	1	2	3	4
Sample Crew	**Personnel**	M	T	W	Th	F	Sa	Su
Boat Crew A	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff							
Boat Crew B	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff							
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL			**Site Mobilization** Mobilize processing trailer. Final equipment and supply check.	**Site Mobilization** Mobilze processing trailer. Final equipment and supply check.	Off	Off	Off

TABLE 3-3a
Detailed Field Schedule, Stage 1
Upper Columbia River RI/FS

WEEK 2

		September						
		5	6	7	8	9	10	11
Sample Crew	**Personnel**	**M**	**T**	**W**	**Th**	**F**	**Sa**	**Su**
Boat Crew A	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff		**FSCA 2 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Mobilize to FSCA 2 (access and fishing methods will be affected by water level). Set up to six gill nets (netting locations will be limited and may be only outside the FSCA) Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station. Assist with processing if necessary	**FSCA 2 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Mobilize to FSCA 2 (access and fishing methods will be affected by water level). Set up to six gill nets (netting locations will be limited and may be only outside the FSCA) Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station. Assist with processing if necessary	**FSCA 2 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Mobilize to FSCA 2 (access and fishing methods will be affected by water level) Set up to six gill nets (netting locations will be limited and may be only outside the FSCA) Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station Assist with processing if necessary	**FSCA 2 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Mobilize to FSCA 2 (access and fishing methods will be affected by water level) Set up to six gill nets (netting locations will be limited and may be only outside the FSCA) Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station Assist with processing if necessary	**FSCA 2 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Mobilize to FSCA 2 (access and fishing methods will be affected by water level) Set up to six gill nets (netting locations will be limited and may be only outside the FSCA) Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station Assist with processing if necessary	Off
Boat Crew - B	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff		**FSCA 1 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Mobilize to FSCA 1 (access and fishing methods will be affected by water level). Set up to six gill nets (netting locations will be limited and may be only outside the FSCA). Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station. Assist with processing if necessary	**FSCA 1 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Retrieve gill nets Count and tag fish Set gill nets Electrofish Count and tag fish Transport fish to onshore station. Assist with processing if necessary.	**FSCA 1 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Retrieve gill nets Count and tag fish Set gill nets Electrofish Count and tag fish Transport fish to onshore station. Assist with processing if necessary	**FSCA 1 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Retrieve gill nets Count and tag fish Set gill nets Electrofish Count and tag fish Transport fish to onshore station Assist with processing if necessary	**FSCA 1 - Lake Whitefish, Rainbow Trout, Walleye, and Largescale Sucker** Retrieve gill nets Count and tag fish Electrofish if necessary Count and tag fish Transport fish to onshore station Assist with processing if necessary	Off
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL	Off	**Site Mobilization** Prepare station for fish processing Meet boat crews near lower reservoir to pick up coolers of whitefish Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of whitefish. Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of whitefish. Process fish and freeze Arrange dry ice for Monday	Meet Boat Crews at designated meeting time and location to pick up coolers of whitefish Process fish and freeze Arrange dry ice for Monday	Off	Off

TABLE 3-3a
Detailed Field Schedule, Stage 1
Upper Columbia River RI/FS

WEEK 3

Sample Crew	Personnel	September 12 M	13 T	14 W	15 Th	16 F	17 Sa	18 Su
Boat Crew A	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff	**FSCA 4 - Lake Whitefish** FTL will meet with SPC in morning for sample documentation and COC forms. Package and prepare samples for shipping. Boat operator and tech – morning off. Set six nets at FSCA 4 for lake whitefish.	**FSCA 4 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will move to FSCA 6 to set gill nets.	**FSCA 4 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will move to FSCA 6 to set gill nets.	**FSCA 4 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will move to FSCA 6 to set gill nets.	**FSCA 4 - Lake Whitefish** Retrieve gill nets Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of whitefish has not been collected, the FTL will consult with the STL about additional nights of gill netting at FSCA 5.	Off	Off
Boat Crew B	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff	**FSCA 3 - Lake Whitefish** FTL will meet with SPC in morning for sample documentation and COC forms. Package and prepare samples for shipping. Boat operator and tech – morning off. Set six nets at FSCA 3 for lake whitefish.	**FSCA 3 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will move to FSCA 5 to set gill nets.	**FSCA 3 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will move to FSCA 5 to set gill nets.	**FSCA 3 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will move to FSCA 5 to set gill nets.	**FSCA 3 - Lake Whitefish** Retrieve gill nets. Count fish. Reset nets if necessary. Deliver fish to onshore station, assist with processing. Note: If the target number of whitefish has not been collected, the FTL will consult with the STL about additional nights of gill netting at FSCA 3.	Off	Off
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL	Pick up dry ice. Sample documentation. COC/tracking forms. Prepare shipment to offsite processing laboratory.	Ship whitefish from FSCA 5 and 6 to offsite processing laboratory. Meet boat crews at designated meeting time and location to pick up coolers of whitefish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of whitefish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of whitefish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of whitefish. Process fish and freeze. Arrange dry ice for Monday.	Off	Off

TABLE 3-3a
Detailed Field Schedule, Stage 1
Upper Columbia River RI/FS

WEEK 4

		September							
		19	20	21	22	23	24	25	26
Sample Crew	Personnel	M	T	W	Th	F	Sa	Su	M
Boat Crew A	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff	**FSCA 6 - Lake Whitefish** Mobilization, equipment testing and setup. Practice setting deep nets for lake whitefish Set six nets at FSCA 6 for lake whitefish.	**FSCA 6 - Lake Whitefish** Retrieve gill nets Count fish. Reset nets if necessary Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will assist crew 2 or return to FSCAs with fewer than target number whitefish collected.	**FSCA 6 - Lake Whitefish** Retrieve gill nets. Count fish Reset nets if necessary Deliver fish to onshore station, assist with processing. Note: If the target number of fish was reached, the crew will assist crew 2 or return to FSCAs with fewer than target number whitefish collected.	**FSCA 6 - Lake Whitefish** Retrieve gill nets Count fish Reset nets if necessary Deliver fish to onshore station, assist with processing. Note: If the target number of whitefish has not been collected, the FTL will consult with the STL about additional nights of gill netting at FSCA 6	**FSCA 6 (optional) - Lake Whitefish** Retrieve nets if necessary. Deliver fish to onshore station Assist with processing Nets will not be reset All or part of day will be nonworking	Demobilize – boat operator and technician are finished		
Boat Crew B	Field Team Leader - CH2M HILL Vessel Operator - STI Fisheries Biologist Sample Technician - STI Staff	**FSCA 5 - Lake Whitefish** Mobilization, equipment testing and setup Practice setting deep nets for lake whitefish Set six nets at FSCA 6 for lake whitefish	**FSCA 5 - Lake Whitefish** Retrieve gill nets Count fish. Reset nets if necessary Deliver fish to onshore station, assist with processing Note If the target number of fish was reached, the crew will assist crew 1 or return to FSCAs with fewer than target number whitefish collected	**FSCA 5 - Lake Whitefish** Retrieve gill nets Count fish Reset nets if necessary Deliver fish to onshore station, assist with processing Note: If the target number of fish was reached, the crew will assist crew 1 or return to FSCAs with fewer than target number whitefish collected	**FSCA 5 - Lake Whitefish** Retrieve gill nets Count fish Reset nets if necessary Deliver fish to onshore station, assist with processing Note if the target number of whitefish has not been collected, the FTL will consult with the STL about additional nights of gill netting at FSCA 5	**FSCA 5 (optional) - Lake Whitefish** Retrieve nets if necessary Deliver fish to onshore station Assist with processing Nets will not be reset All or part of day will be nonworking	Demobilize – boat operator and technician are finished		
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL	Pick up dry ice Sample documentation COC/tracking forms Prepare shipment to offsite processing laboratory	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze	OH	Pick up dry ice Sample documentation COC tracking forms Prepare shipment to offsite processing laboratory

TABLE 3-3b
Detailed Field Schedule, Stage 2
Upper Columbia River RI/FS

WEEK 1

		October							
		9	10	11	12	13	14	15	16
Sample Crew	**Personnel**	**Su**	**M**	**T**	**W**	**Th**	**F**	**Sa**	**Su**
Boat Crew C	Field Team Leader - CH2M HILL Vessel Operator - CCT Fisheries Biologist Sample Technician - CCT Staff			**Site Mobilization** Mobilize equipment and test setup. Review and rehearse sampling approach. Final equipment and supply check.	**FSCA 1 - All Species** Mobilize to FSCA 1 (access and fishing methods will be affected by water level). Set up to four gill nets (netting locations will be limited and may be only outside the FSCA). Electrofish (may require daytime electrofishing for safety reasons). Transport fish to onshore station.	**FSCA 1 - All Species** Retrieve gill nets Count and tag fish. Set gill nets Electrofish Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 2 - All Species** Retrieve gill nets from FSCA 1. Count and tag fish. Mobilize to FSCA 2 (access and fishing methods will be affected by water level). Set up to four gill nets (netting locations will be limited and may be only outside the FSCA). Electrofish (may require daytime electrofishing for safety reasons) Transport fish to onshore station.	**FSCA 2 - All Species** Retrieve gill nets Count and tag fish. Set gill nets. Electrofish Count and tag fish. Transport fish to onshore station Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 2 - All Species** Retreve gill nets. Count and tag fish. Transport fish to onshore station.
Boat Crew D	Field Team Leader - CH2M HILL Vessel Operator - USFWS Fisheries Biologist Sample Technician - USFWS Staff			**Site Mobilization** *Mobilize equipment and test* setup. Review and rehearse sampling approach. Final equipment and supply check.	**FSCA 1 - All Species** *Mobilize to FSCA 1* (access and fishing methods will be affected by water level). Set up to four gill nets (netting locations will be limited and may be only outside the FSCA). Electrofish (may require daytime electrofishing for safety reasons). Transport fish to onshore+F22 station.	**FSCA 1 - All Species** *Retreve gill nets.* Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 2 - All Species** *Retreve gill nets from* FSCA 1. Count and tag fish. Mobilize to FSCA 2 (access and fishing methods will be affected by water level). Set up to four gill nets (netting locations will be limited and may be only outside the FSCA). Electrofish (may require daytime electrofishing for safety reasons). Transport fish to onshore station.	**FSCA 2 - All Species** *Retrieve gill nets.* Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 2 - All Species** Retreve gill nets. Count and tag fish. Transport fish to onshore station.

TABLE 3-3b
Detailed Field Schedule, Stage 2
Upper Columbia River RI/FS

WEEK 1		October							
Sample Crew	Personnel	9 Su	10 M	11 T	12 W	13 Th	14 F	15 Sa	16 Su
Boat Crew E	Field Team Leader - CH2M HILL Vessel Operator - USEPA Fisheries Biologist Sample Technician - USEPA Staff			**Site Mobilization** Mobilize equipment and test setup. Review and rehearse sampling approach Final equipment and supply check	**FSCA 1 - All Species** Mobilize to FSCA 1 (access and fishing methods will be affected by water level) Set up to four gill nets (netting locations will be limited and may be only outside the FSCA). Set up to 12 burbot pots (locations will be limited and may be outside the FSCA). Assist in electrofishing if time permits (may require daytime electrofishing for safety reasons). Transport fish to onshore station.	**FSCA 1 - All Species** Retrieve gill nets Count and tag fish Set gill nets. Retrieve burbot pots Count and tag fish Transport fish to onshore station Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 2 - All Species** Retrieve gill nets and burbot pots from FSCA 1. Count and tag fish Mobilize to FSCA 2 (access and fishing methods will be affected by water level) Set up to four gill nets (netting locations will be limited and may be only outside the FSCA) Set up to 12 burbot pots (locations will be limited and may be outside the FSCA). Assist in electrofishing if time permits (may require daytime electrofishing for safety reasons) Transport fish to onshore station.	**FSCA 2 - All Species** Retrieve gill nets Count and tag fish. Set gill nets. Retrieve burbot pots. Count and tag fish Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued	**FSCA 2 - All Species** Retrieve gill nets and burbot pots Count and tag fish. Transport fish to onshore station
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL Sample Processing Technician - CH2M HILL	**Site Mobilization** Mobilize processing trailer Final equipment and supply check	**Site Mobilization** Mobilize processing trailer Final equipment and supply check	**Site Mobilization** Mobilize processing trailer Final equipment and supply check.	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze. Arrange dry ice for Monday.	Meet boat crews at designated meeting time and location to pick up coolers of fish Process fish and freeze

TABLE 3-3b
Detailed Field Schedule, Stage 2
Upper Columbia River RI/FS

WEEK 2

		October						
		17	18	19	20	21	22	23
Sample Crew	Personnel	M	T	W	Th	F	Sa	Su
Boat Crew C	Field Team Leader - CH2M HILL Vessel Operator - CCT Fisheries Biologist Sample Technician - CCT Staff	Off	**FSCA 3 - All Species Except Whitefish** Mobilize to FSCA 3. Set up to four gill nets. Electrofish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 3 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 4 - All Species Except Whitefish** Retrieve gill nets from FSCA 3. Count and tag fish. Mobilize to FSCA 4. Set up to four gill nets. Electrofish. Transport fish to onshore station.	**FSCA 4 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 4 - All Species** Retrieve gill nets. Count and tag fish. Transport fish to onshore station.	Off
Boat Crew D	Field Team Leader - CH2M HILL Vessel Operator - USFWS Fisheries Biologist Sample Technician - USFWS Staff	Off	**FSCA 3 - All Species except Whitefish** Mobilize to FSCA 3. Set up to four gill nets. Electrofish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 3 - All Species expect Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 4 - All Species except Whitefish** Retrieve gill nets from FSCA 3. Count and tag fish. Mobilize to FSCA 4. Set up to four gill nets. Electrofish. Transport fish to onshore station.	**FSCA 4 - All Species Expect Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station Note. If electrofishing is more effective than gill netting, gill netting may be discontinued	**FSCA 4 - All Species** Retrieve gill nets. Count and tag fish. Transport fish to onshore station.	Off
Boat Crew E	Field Team Leader - CH2M HILL Vessel Operator - USEPA Fisheries Biologist Sample Technician - USEPA Staff	Off	**FSCA 3 - All Species Except Whitefish** Mobilize to FSCA 3 Set up to four gill nets. Set up to 12 burbot pots. Assist in electrofish if time permits. Transport fish to onshore station.	**FSCA 3 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Retrieve burbot pots. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 4 - All Species Except Whitefish** Retrieve gill nets and burbot pots from FSCA 3 Count and tag fish. Mobilize to FSCA 4. Set up to four gill nets. Set up to 12 burbot pots. Assist in electro fish if time permits. Transport fish to onshore station.	**FSCA 4 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets Retrieve burbot pots. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 4 - All Species** Retrieve gill nets and burbot pots. Count and tag fish. Transport fish to onshore station.	Off
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL Sample Processing Technician - CH2M HILL	Off	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze. Pick up dry ice. Sample documentation. COC/tracking forms. Prepare shipment to offsite processing laboratory.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Off

TABLE 3-3b
Detailed Field Schedule, Stage 2
Upper Columbia River RI/FS

WEEK 3

		October							
		24	25	26	27	28	29	30	1
Sample Crew	**Personnel**	**M**	**T**	**W**	**Th**	**F**	**Sa**	**Su**	**M**
Boat Crew C	Field Team Leader - CH2M HILL Vessel Operator - CCT Fisheries Biologist Sample Technician - CCT Staff	**FSCA 5 - All Species Except Whitefish** Mobilize to FSCA 5. Set up to four gill nets. Electrofish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued	**FSCA 5 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 6 - All Species Except Whitefish** Retrieve gill nets from FSCA 5. Count and tag fish. Mobilize to FSCA 6. Set up to four gill nets. Electrofish. Transport fish to onshore station.	**FSCA 6 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 6 - All Species** Retrieve gill nets. Count and tag fish. Transport fish to onshore station. **Demobilize and leave.**			
Boat Crew D	Field Team Leader - CH2M HILL Vessel Operator - USFWS Fisheries Biologist Sample Technician - USFWS Staff	**FSCA 5 - All Species Except Whitefish** Mobilize to FSCA 5. Set up to four gill nets. Electrofish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 5 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 6 - All Species Except Whitefish** Retrieve gill nets from FSCA 5. Count and tag fish. Mobilize to FSCA 6. Set up to four gill nets. Electrofish. Transport fish to onshore station.	**FSCA 6 - All Species Expect Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Electrofish. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 6 - All Species** Retrieve gill nets. Count and tag fish. Transport fish to onshore station. **Demobilize and leave.**			
Boat Crew E	Field Team Leader - CH2M HILL Vessel Operator - USEPA Fisheries Biologist Sample Technician - USEPA Staff	**FSCA 5 - All Species Except Whitefish** Mobilize to FSCA 5. Set up to 4 gill nets. Set up to 12 burbot pots. Assist in electrofishing if time permits. Transport fish to onshore station.	**FSCA 5 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Retrieve burbot pots. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 6 - All Species Except Whitefish** Retrieve gill nets and burbot pots from FSCA 5. Count and tag fish. Mobilize to FSCA 6. Set up to 4 gill nets. Set up to 12 burbot pots. Assist in electro fish if time permits. Transport fish to onshore station.	**FSCA 6 - All Species Except Whitefish** Retrieve gill nets. Count and tag fish. Set gill nets. Retrieve burbot pots. Count and tag fish. Transport fish to onshore station. Note: If electrofishing is more effective than gill netting, gill netting may be discontinued.	**FSCA 6 - All Species** Retrieve gill nets and burbot pots. Count and tag fish. Transport fish to onshore station. **Demobilize and leave.**			
Processing Crew	Sampling Team Leader - CH2M HILL Sample Processing Coordinator - CH2M HILL Sample Processing Technician - CH2M HILL Sample Processing Technician - CH2M HILL	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze. Pick up dry ice. Sample documentation COC/tracking forms. Prepare shipment to offsite processing laboratory.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Meet boat crews at designated meeting time and location to pick up coolers of fish. Process fish and freeze.	Off	Demob	Sample documentation COC tracking forms. Prepare shipments to offsite processing laboratory. Finish demob.

TABLE 3-4
Equipment and Supply List for Onboard Fish Collection Activities
Upper Columbia River RI/FS

Description	Quantity
Sampling vessel (including boat, motor, oars, fuel, adequate lighting and required safety equipment)	1
Electrofishing equipment (including voltage pulsator unit, generator, electrodes, wiring cables, dip nets, protective gloves, protective boots, all necessary safety equipment)	1
Gill nets (including anchors, depth adjustment lines, and locator floats)	6
U.S. Coast Guard (USCG)-approved personal flotation devices	3
Maps of sampling areas and sites	1
GPS unit	1
Depth finder	1
Livewell(s)	1
Ice chests for fish containers (and waterproof container labels)	6
Buckets	2
Ice	6 x 6 = 36
Measuring boards and/or templates of target size ranges	2
Plastic bags	1 roll
Knife and/or scissors	1
Clean nitrile gloves	1 box
Copy of QAPP	1
Field forms and chain-of-custody forms (on clipboard)	12
Fish identification tags and ties	30
Black ballpoint pens, pencils, and sharpies	4 ea
Scientific collection permit	1
First aid kit	1
Marine-band radio	1
Cell phone and numbers	1
Digital camera with batteries and memory cards	1
Head lamp	1 per person

TABLE 3-5
Fish External Features to be Examined for Anomalies
Upper Columbia River RI/FS

External Feature	Condition	Description
Eyes	Normal	No aberrations evident – good clear eye
	Exopthalmia	Swollen, protruding eye - "Popeye"
	Hemorrhagic	Bleeding in the eye
	Blind	Opaque eyes
	Missing	An eye is missing from the fish
	Other	Any manifestations that do not fit the above categories
Skin	Normal	No aberrations
	Mild	Mild aberrations present
	Moderate	Moderate aberrations present
	Severe	Severe aberrations present
Fins	No active erosion	Normal-appearing fins with no active erosion, including previously eroded fins that have been completely healed over
	Mild active erosion	Active erosion process with no hemorrhage and/or secondary infection
	Severe active erosion	Active erosion with hemorrhage and/or secondary infection
	Other	Indicate which fins were eroded and any other observation of special significance
Parasites	None	No parasites observed
	Few	Few parasites observed
	Moderate	Moderate parasites observed
	Numerous	Numerous parasites observed
Gills	Normal	No apparent manifestations in the gills
	Frayed	Erosion of the tips of the gill lamellae—ragged in appearance
	Clubbed	Swelling of the tips of the gills
	Marginate	Gill with a light discolored margin along the distal ends or tips of the lamellae or filaments; often associated with clubbing
	Pale	Gills very light in color; may be more prevalent in gill net collected fish (fish that have been dead for a certain time period)
	Other	Any other observation that does not fit the above categories
Pseudobranchs	Normal	Flat or concave in aspect and displaying no aberrations
	Swollen	Obviously convex in aspect

TABLE 3-5
Fish External Features to be Examined for Anomalies
Upper Columbia River RI/FS

External Feature	Condition	Description
	Lithic	Mineral deposits in pseudobranchs, white in appearance, and somewhat amorphous spots or foci
	Swollen and Lithic	Lithic and swollen pseudobranchs
	Inflamed	Inflamed (redness)—signs of hemorrhaging
	Other	Any other observation that does not fit the above categories
Thymus	No hemorrhage	No hemorrhaging is believed to be a normal condition, but this condition is still under investigation
	Mild hemorrhage	A few red spots or petechial hemorrhages evident; might only be two or three spots
	Severe hemorrhage	Many "pin-point" hemorrhages, with some of them coalescing, area may have a swollen tumescent appearance that should be recorded in remarks
Opercles	Normal opercle	No shortenings; gills completely covered
	Slight shortening	Slight shortening of the opercle with a very small portion of the gill exposed
	Severe shortening	Severe shortening of the opercles, with a considerable portion of the gill exposed

TABLE 3-6
Container Materials, Preservation, and Holding Times
for Fish Samples from Receipt at CH2M HILL Processing Laboratory to Analysis
Upper Columbia River RI/FS

Analyte	Matrix	Sample Container Material	Storage	
			Preservation	Holding Time
Mercury	Tissue (whole specimens, homogenates)	Plastic, borosilicate glass, quartz, and Teflon[a]	Freeze at ≤ –20 °C	6 months[b]
Other metals	Tissue (whole specimens, homogenates)	Plastic, borosilicate glass, quartz, and Teflon	Freeze at ≤ –20 °C	6 months
Organics	Tissue (whole specimens, homogenates)	Borosilicate glass, quartz, Teflon, and aluminum foil	Freeze at ≤ –20 °C	1 year
Lipids	Tissue (whole specimens, homogenates)	Plastic, borosilicate glass, quartz, Teflon	Freeze at ≤ –20°C	1 year

[a] Teflon is the preferred container.

[b] PSEP (1997).

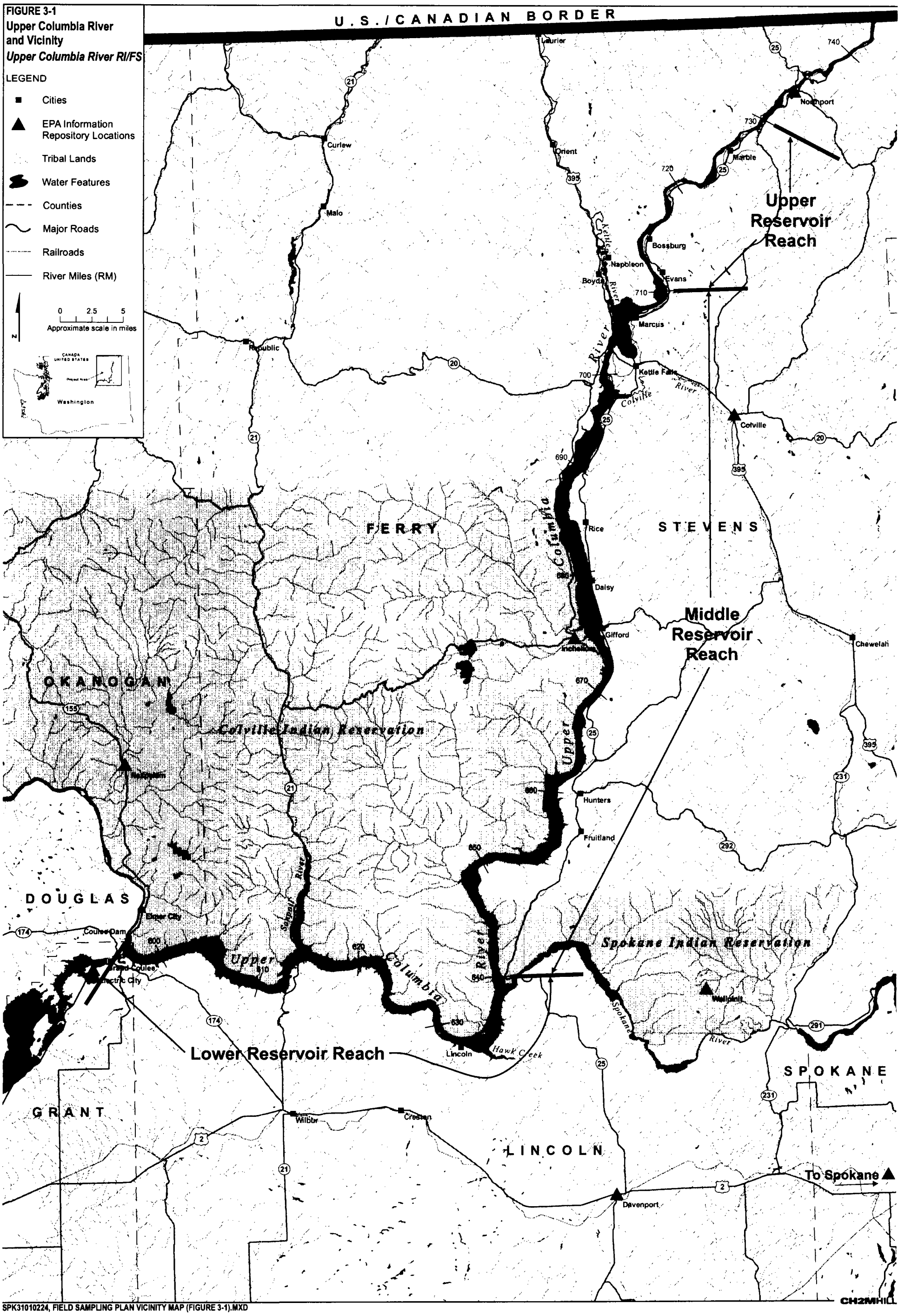
Note: Archive sample containers and sample preservation will also vary by analyte.

Source: USEPA 2000c.

TABLE 3-7
Equipment for Processing of Fillet and Whole-Body Samples
Upper Columbia River RI/FS

Process	Equipment List
Scaling	Multiple glass or Teflon cutting boards
	Heavy-duty aluminum foil
	Stainless steel, ceramic, or titanium knives
	Contaminant-free distilled water
Filleting	Nitrile gloves, if gloves are preferred to be worn
	Ivory soap
	Multiple glass or Teflon cutting boards
	Heavy-duty aluminum foil
	Stainless steel, ceramic, or titanium knifes
	Contaminant-free distilled water
	Contaminant-free, deionized distilled water
Homogenization	Clean glass or Teflon homogenization containers
	Automatic grinder, high speed blender, or homogenizer
	Clean Teflon aliquot containers
	Ivory soap
	Contaminant-free distilled water
	Deep freezer, ≤ -20° C
	Dry ice

FIGURE 3-1
Upper Columbia River and Vicinity
Upper Columbia River RI/FS



SPK31010224, FIELD SAMPLING PLAN VICINITY MAP (FIGURE 3-1).MXD

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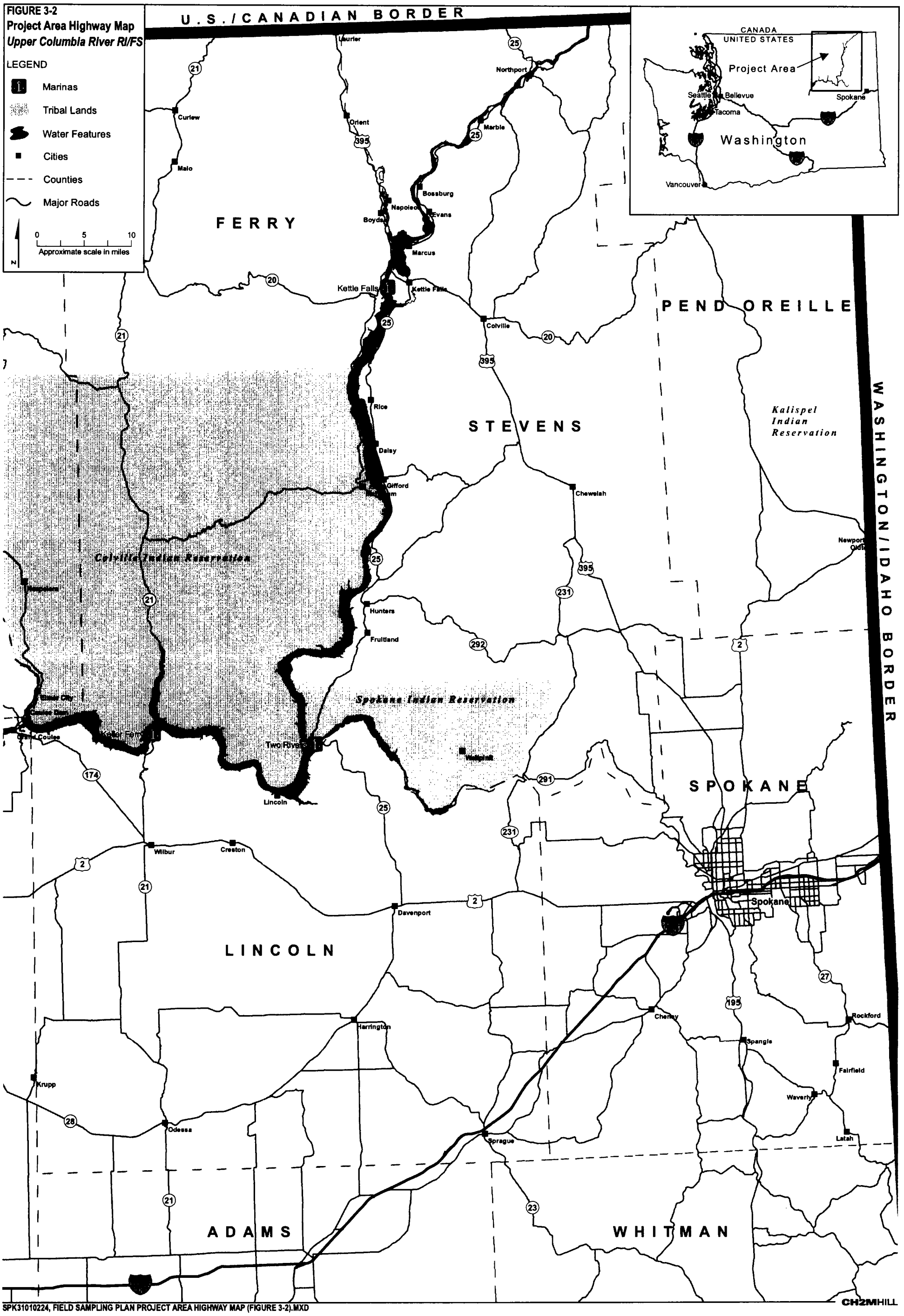
FIGURE 3-2
Project Area Highway Map
Upper Columbia River RI/FS



SPK31010224, FIELD SAMPLING PLAN PROJECT AREA HIGHWAY MAP (FIGURE 3-2).MXD

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FIGURE 3-3
Proposed Fish Tissue Sampling Collection Areas
Upper Columbia River RI/FS

LEGEND

- Fish Sampling Collection Areas
- Sediment Sampling Focus Areas
- Tribal Lands
- Water Features
- Cities
- Counties
- Major Roads

0 2.5 5
Approximate scale in miles

U.S./CANADIAN BORDER

Fish Sampling Collection Area #1
Sediment Sampling Focus Area #1
Northport
Laurier
Upper Extent of Lake Roosevelt National Recreation Area
Curlew
Orient
Sediment Sampling Focus Area #2
Marble
Fish Sampling Collection Area #2
Malo
Bossburg
Napoleon
Evans
Boyds
Fish Sampling Collection Area #3
Marcus
Sediment Sampling Focus Area #3
Republic
Kettle Falls
Colville
FERRY
STEVENS
Rice
Sediment Sampling Focus Area #4
Daisy
Fish Sampling Collection Area #4
Gifford
Inchelium
Chewelah
OKANOGAN
Colville Indian Reservation
Nespelem
Hunters
Fruitland
Lower Extent of Lake Roosevelt National Recreation Area
DOUGLAS
Elmer City
Fish Sampling Collection Area #6
Coulee Dam
Grand Coulee
Electric City
Sediment Sampling Focus Area #6
Sediment Sampling Focus Area #5
Spokane Indian Reservation
Wellpinit
Fish Sampling Collection Area #5
Lincoln
GRANT
Wilbur
Creston
LINCOLN
SPOKANE
Davenport

SPK31010224, PROPOSED TISSUE SAMPLE LOCATIONS FIGURE 3-3 (1TO63360).MXD

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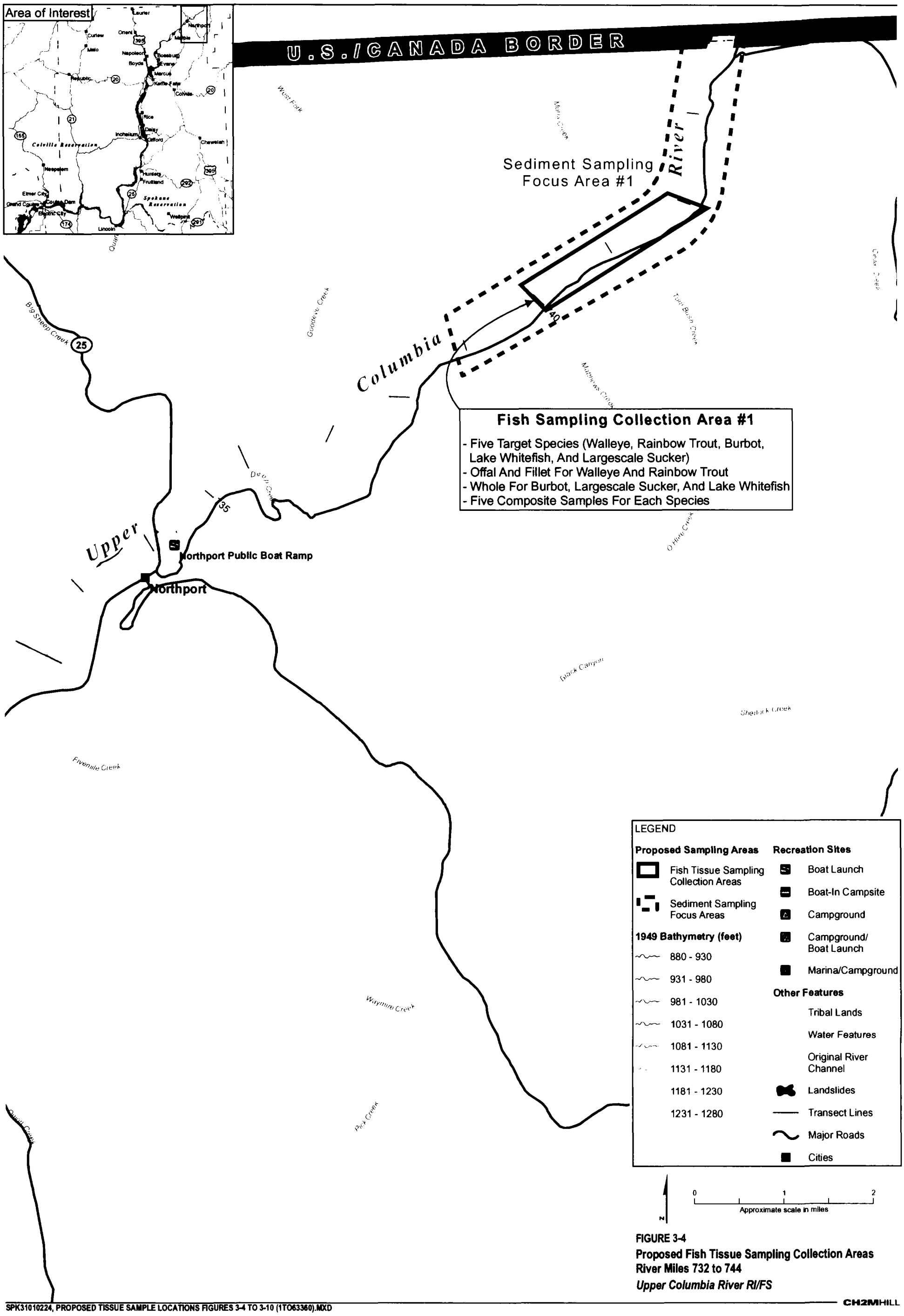

FIGURE 3-4
Proposed Fish Tissue Sampling Collection Areas
River Miles 732 to 744
Upper Columbia River RI/FS

SPK31010224, PROPOSED TISSUE SAMPLE LOCATIONS FIGURES 3-4 TO 3-10 (1TO63360).MXD

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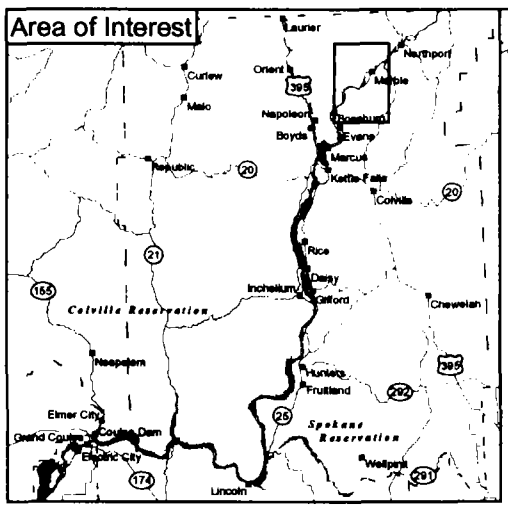
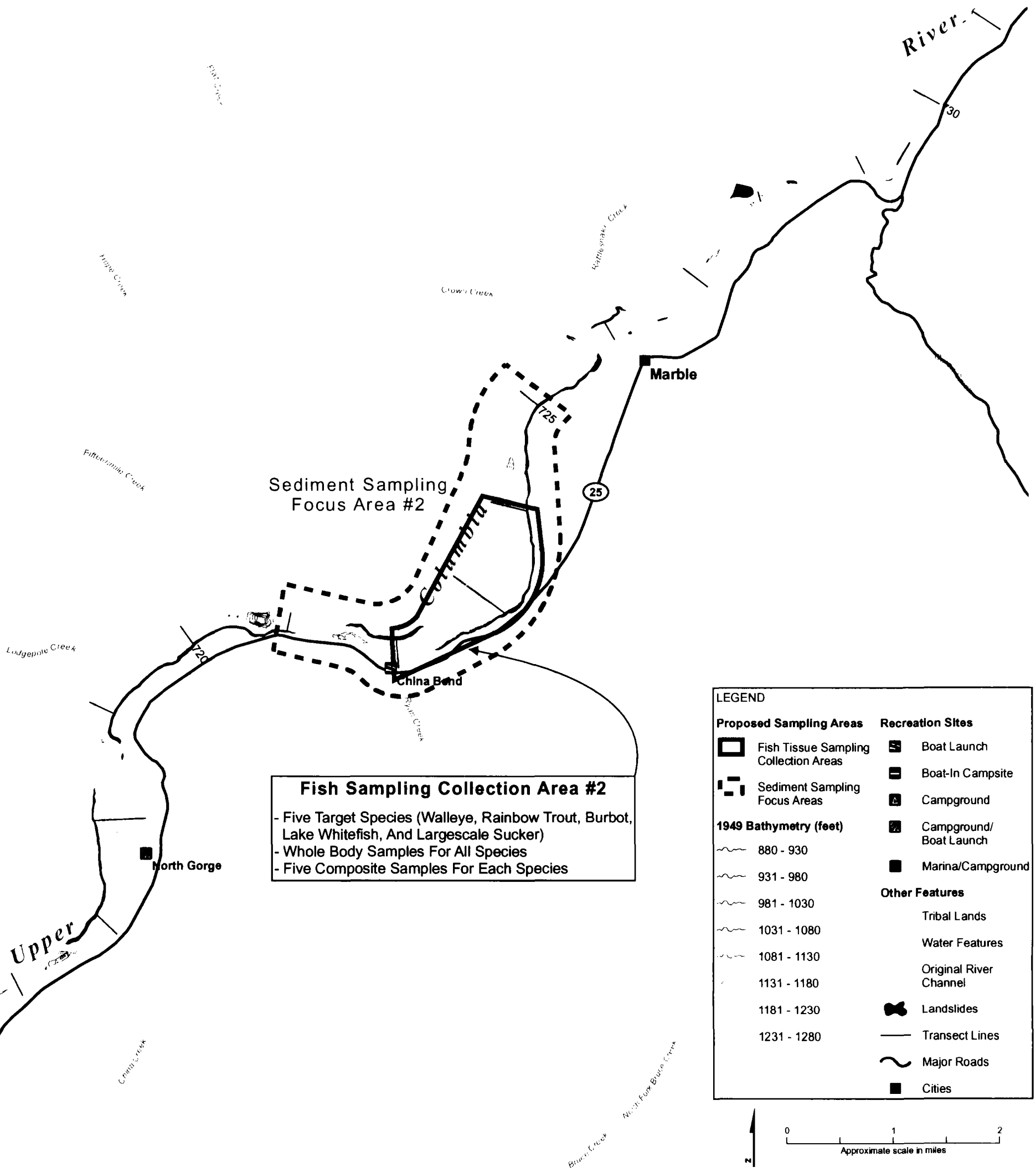




Fish Sampling Collection Area #2

- Five Target Species (Walleye, Rainbow Trout, Burbot, Lake Whitefish, And Largescale Sucker)
- Whole Body Samples For All Species
- Five Composite Samples For Each Species

LEGEND

Proposed Sampling Areas

- Fish Tissue Sampling Collection Areas
- Sediment Sampling Focus Areas

1949 Bathymetry (feet)

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Recreation Sites

- Boat Launch
- Boat-In Campsite
- Campground
- Campground/ Boat Launch
- Marina/Campground

Other Features

- Tribal Lands
- Water Features
- Original River Channel
- Landslides
- Transect Lines
- Major Roads
- Cities

N

0 1 2

Approximate scale in miles

FIGURE 3-5

Proposed Fish Tissue Sampling Collection Areas
River Miles 716 to 731
Upper Columbia River RI/FS

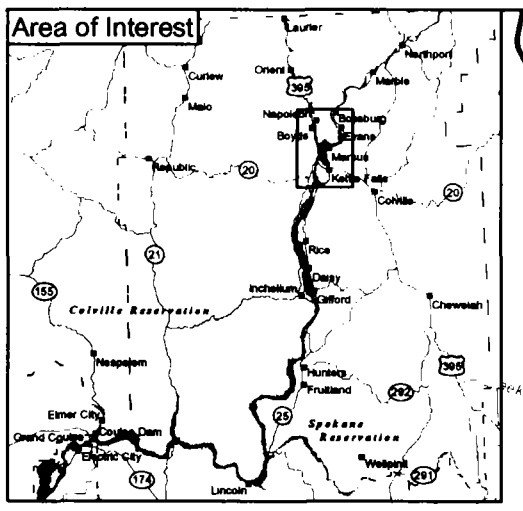


FIGURE 3-6
Proposed Fish Tissue Sampling Collection Areas
River Miles 697 to 715
Upper Columbia River RI/FS

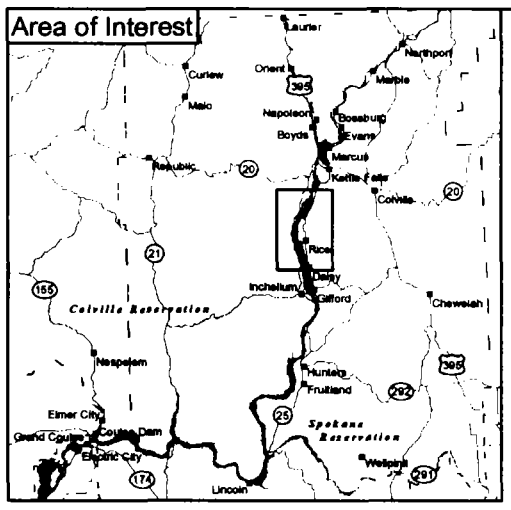
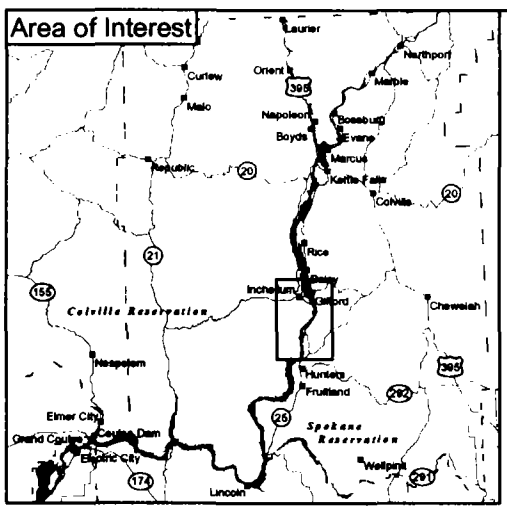


FIGURE 3-7

Proposed Fish Tissue Sampling Collection Areas
River Miles 679 to 696
Upper Columbia River RI/FS



Sediment Sampling Focus Area #4

Cobbs Creek

Hall Creek

Inchelium

Gifford

Cloverleaf Beach

Buck Canyon

Deer Creek

Comstalk Creek

Stranger Creek

Fish Sampling Collection Area #4

- Five Target Species (Walleye, Rainbow Trout, Burbot, Lake Whitefish, And Largescale Sucker)
- Whole Body Samples For All Species
- Five Composite Samples For Each Species

Note: Collection Area #4 Displayed on Figures 3-7 & 3-8

AA Encampment

Colville Indian Reservation

Columbia River

Stray Dog Canyon

Nez Perce Creek

Harvey Creek

Falls Creek

25

665

675

670

LEGEND

Proposed Sampling Areas

- Fish Tissue Sampling Collection Areas
- Sediment Sampling Focus Areas

1949 Bathymetry (feet)

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Recreation Sites

- Boat Launch
- Boat-In Campsite
- Campground
- Campground/ Boat Launch
- Marina/Campground

Other Features

- Tribal Lands
- Water Features
- Original River Channel
- Landslides
- Transect Lines
- Major Roads
- Cities

N

0 1 2

Approximate scale in miles

FIGURE 3-8

Proposed Fish Tissue Sampling Collection Areas
River Miles 663 to 678
Upper Columbia River RI/FS

SPK31010224, PROPOSED TISSUE SAMPLE LOCATIONS FIGURES 3-4 TO 3-10 (1TO63360).MXD

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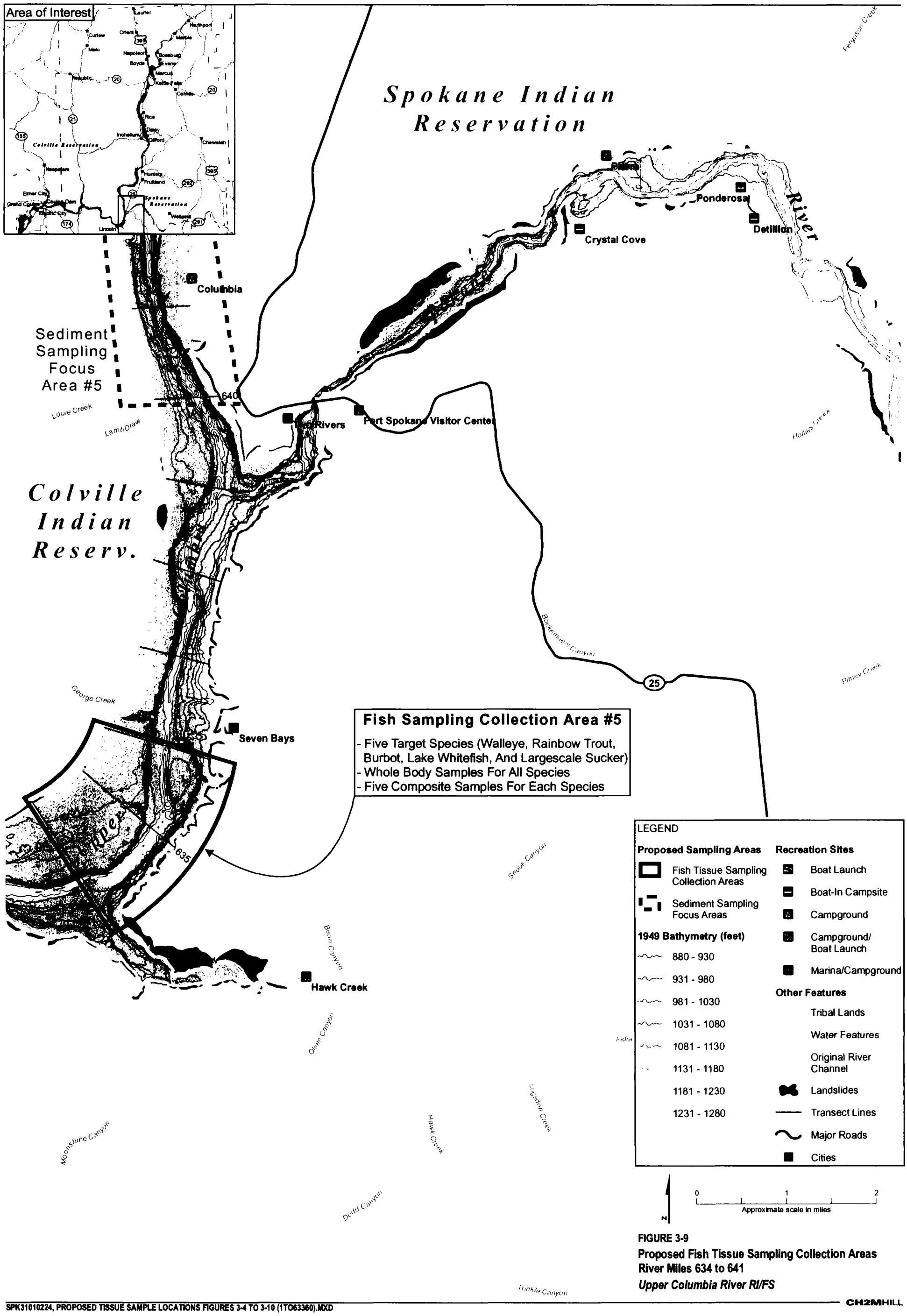
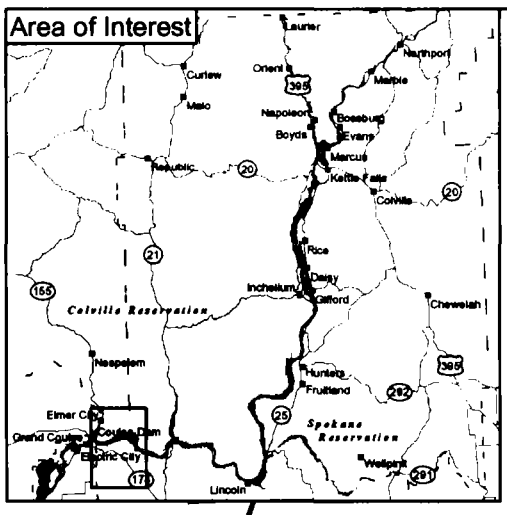
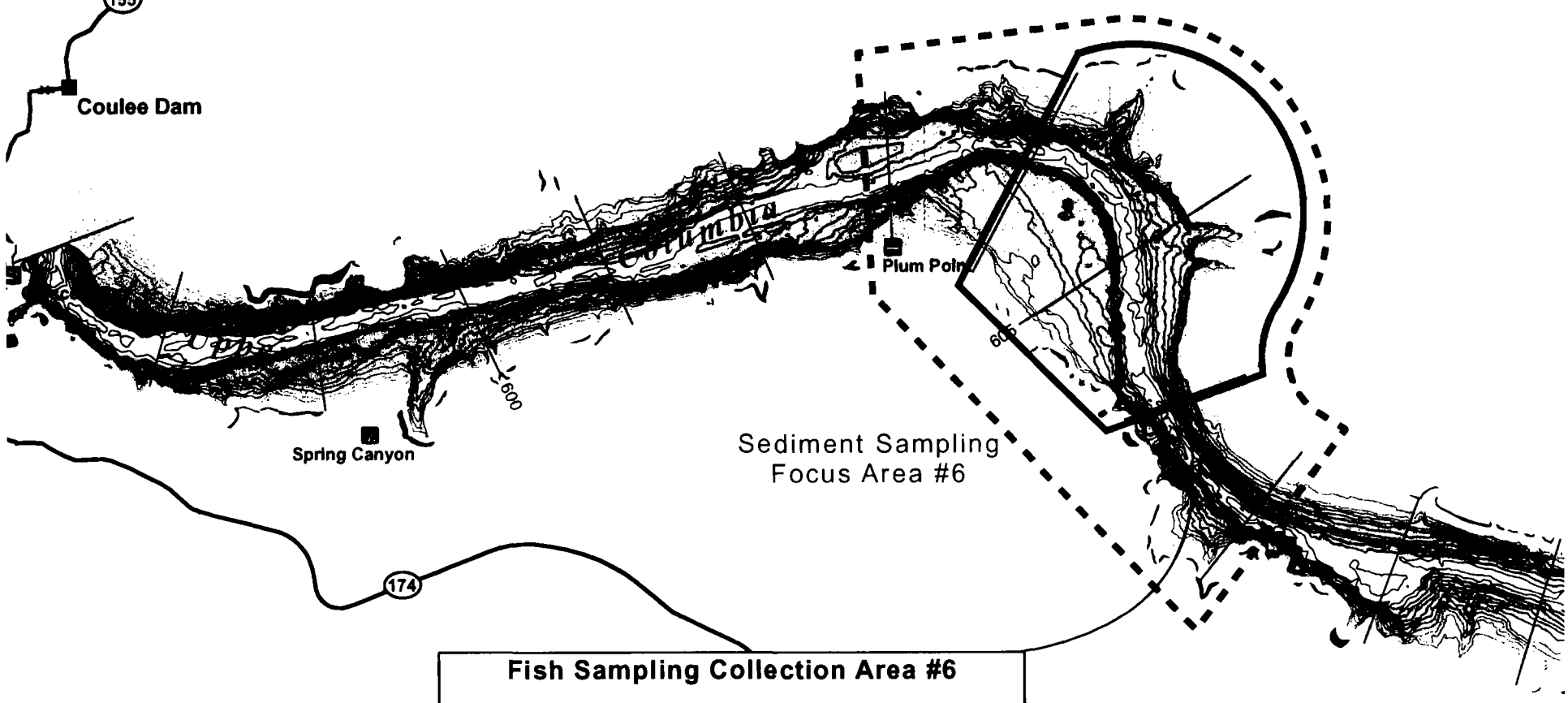


FIGURE 3-9

Proposed Fish Tissue Sampling Collection Areas
River Miles 634 to 641
Upper Columbia River RI/FS



Colville Indian Reservation



Fish Sampling Collection Area #6

- Five Target Species (Walleye, Rainbow Trout, Burbot, Lake Whitefish, And Largescale Sucker)
- Offal And Fillet For Walleye And Rainbow Trout
- Whole For Burbot, Largescale Sucker, And Lake Whitefish
- Five Composite Samples For Each Species

LEGEND

Proposed Sampling Areas

- Fish Tissue Sampling Collection Areas
- Sediment Sampling Focus Areas

1949 Bathymetry (feet)

- 880 - 930
- 931 - 980
- 981 - 1030
- 1031 - 1080
- 1081 - 1130
- 1131 - 1180
- 1181 - 1230
- 1231 - 1280

Recreation Sites

- Boat Launch
- Boat-In Campsite
- Campground
- Campground/ Boat Launch
- Marina/Campground

Other Features

- Tribal Lands
- Water Features
- Original River Channel
- Landslides
- Transect Lines
- Major Roads
- Cities

N

0 1 2

Approximate scale in miles

FIGURE 3-10

Proposed Fish Tissue Sampling Collection Areas
River Miles 595 to 609

Upper Columbia River RI/FS

SECTION 4

Assessment and Oversight (USEPA Group C)

SECTION 4

Assessment and Oversight (USEPA Group C)

4.1 Assessments and Response Actions (C1)

The QAO, senior reviewers, and PM will monitor the performance of the QA procedures. If problems arise and/or the USEPA TOPO directs the PM accordingly, the QAO will conduct field audits. Field audits may be scheduled to evaluate (1) the execution of sample identification, chain-of-custody procedures, field notebooks, sampling procedures, and field measurements; (2) whether trained personnel staffed the sample event; (3) whether equipment was in proper working order (that is, calibration); (4) availability of proper sampling equipment; (5) whether appropriate sample containers, sample preservatives, and techniques were used; (6) whether sample packaging and shipment were appropriate; and (7) whether QC samples were properly collected.

An audit of the tissue homogenization procedures will be conducted prior to sample collection by a team composed of the USEPA PM, QAO, and chemists/biologists and the CH2M HILL QAO and PM. The fish filleting and homogenization SOP will be sent to the USEPA QAO. The audit may involve filleting and homogenizing mock samples that will be analyzed at MEL to identify potential problems with sample handling and processing. Field samples will not be filleted or homogenized until the necessary corrective actions addressing any problems identified during the audit are initiated.

Sample analyses will be carried out at the USEPA CLPs, the USEPA MEL, and contract laboratories. The distribution of analyses to the laboratories will be determined according to laboratory capability and capacity and the sampling schedule. The distribution of analyses may change at the time of analyses depending on capacity and implementation of specific procedures at the Regional Laboratory. The RSCC, residing at USEPA's Technical Support Unit (TSU), will be responsible for coordination and scheduling of analytical services from the CLPs and MEL. The data quality and laboratory performance of CLP laboratories are monitored by the Analytical Services Branch in USEPA Headquarters and the region's CLP PO(s). For MEL, QA oversight is provided by the laboratory's QA Coordinator. Laboratories subcontracted outside the USEPA laboratories will be selected based on prior performance on Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) projects. In addition, onsite audits or performance evaluation samples will be administered by the CH2M HILL QAO and USEPA Regional Quality Assurance Manager (QAM), as necessary.

Audits will be followed up with an audit report prepared by the reviewer. The auditor will also debrief the laboratory or the field team at the end of the audit and request that the laboratory or field team comply with the corrective action request.

If QC audits result in detection of unacceptable conditions or data, the PM will be responsible for developing and initiating corrective action. The TOPO will be notified if nonconformance is of program significance or requires special expertise not normally

available to the project team. In such cases, the PM will decide whether any corrective action should be pursued. Corrective action may include the following:

- Reanalyzing samples if holding time criteria permit
- Re-sampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting data acknowledging a level of uncertainty

All corrective actions will be documented on either a field change request form or a corrective action record form, provided in Appendix B.

4.2 Reports to Management (C2)

The PM or TOPO may request that a QA report be made to the TOPO on the performance of sample collection and data quality. The report will include the following:

- Assessment of measurement data accuracy, precision, and completeness
- Results of performance audits
- Results of systems audits
- Significant QA problems and recommended solutions

Progress reports prepared as needed will summarize overall project activities and any problems encountered. QA reports generated on sample collection and data quality will focus on specific problems encountered and solutions implemented. Alternatively, in lieu of a separate QA report, sampling and field measurement data quality information may be summarized and included in the final reports summarizing Phase I activities. The objectives, activities performed, overall results, sampling, and field measurement data quality information for the project will be summarized and included in the final reports along with any QA reports.

SECTION 5

Data Validation and Usability (USEPA Group D)

SECTION 5

Data Validation and Usability (USEPA Group D)

5.1 Data Review, Verification, and Validation (D1)

All data for all parameters will undergo two levels of review and validation: (1) at the laboratory, and (2) outside the laboratory by the USEPA Regional QAM or their designee. All CLP-generated data will be verified and validated by the chemists at USEPA's TSU. The data generated by the subcontracted commercial laboratories will be validated by CH2M HILL or an independent third-party data reviewer.

5.2 Verification and Validation Methods (D2)

Initial data reduction, validation, and reporting at the laboratory will be performed as described in the laboratory standard operating procedures. Independent data validation by USEPA or their designee will follow USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic/Organic Data Review* (USEPA, 1994b, 1999, 2002b) as described above. All CLP-generated data will be verified and validated by the chemists at TSU. The data generated by the subcontracted commercial laboratories will be validated by CH2M HILL or an independent third-party data reviewer. Data generated by MEL will be validated by the USEPA chemists at MEL or TSU.

A full data validation will be performed on all PCB, dioxin and furan, and speciated arsenic analyses. For the metals and mercury analyses, the first four sample delivery groups submitted by the laboratory will undergo full data validation. If problems are not encountered with the data, and because of resource and time constraints, only 30 percent of the metals and mercury data will undergo full data validation and the remaining 70 will undergo summary forms data review. Validation report memoranda and qualified results will be prepared by the validator and submitted to USEPA and the CH2M HILL's PM. Unvalidated laboratory data spreadsheets will be sent by TSU to CH2M HILL.

5.3 Reconciliation with User Requirements (D3)

Results obtained from the project will be reconciled with the requirements specified in Table 2-5. Assessment of data for precision, accuracy, and completeness will be performed in accordance with the quantitative definitions in Section 2.4.2.

SECTION 6

References

SECTION 6

References

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Appendix A
Field Safety Instructions

APPENDIX A

Field Safety Instructions

CH2M HILL FIELD SAFETY INSTRUCTIONS

These Field Safety Instructions (FSI) will be kept onsite during field activities and will be reviewed as necessary. The FSI will be amended or revised as project activities or conditions change or when supplemental information becomes available. The FSI adopt, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, these FSI may adopt procedures from the project Work Plan. The Safety Coordinator (SC) is to be familiar with these SOPs and the content of these instructions. CH2M HILL's personnel and subcontractors must sign Attachment 1 provided at the end of these FSI.

Project Information and Description

PROJECT NO: 315904

CLIENT: U.S. Environmental Protection Agency (USEPA)

PROJECT/SITE NAME: Upper Columbia River, Fish Assessment

CH2M HILL PROJECT MANAGER: Jim Stefanoff/SPK

CH2M HILL OFFICE: Spokane

DATE FIELD SAFETY INSTRUCTIONS PREPARED: August 2005

DATE(S) OF SITE WORK: September 2005 through March 2006

SITE DESCRIPTION AND HISTORY: Pending Superfund site; primarily concerned over mining/milling related impacts on water quality, sediment, and aquatic receptors.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED BY CH2M HILL: Electrofishing, gill netting, fish trapping, angling, and fish tissue sampling.

1.0 Project Organization and Responsibilities

1.1 Client

Contact Name: Sally Thomas/Kevin Rochlin; Task Order Project Officers
Phone: 206-553-2102/2106

1.2 CH2M HILL

Project Manager (PM): Jim Stefanoff/SPK
Health and Safety Manager (HSM): John Culley/SPK
Safety Coordinator (SC): Shaun Roark/SEA

The SC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Verify these FSI are current and amended when project activities or conditions change
- Verify CH2M HILL site personnel and subcontractor personnel read these FSI and sign Attachment 1 prior to commencing field activities
- Verify CH2M HILL site personnel and subcontractor personnel have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance as identified in Section 2.0
- Verify compliance with the requirements of these FSI and applicable subcontractor health and safety plan(s)
- Act as the project Emergency Response Coordinator and perform the responsibilities outlined in Section 4.0
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change)

Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continuous** basis to determine if the current site health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered..*

Project Task:	
Project Number:	Project/Task Manager:
Name:	Employee #:

	Evaluation Checklist	Yes	No
1.	Have the CH2MHILL staff listed in the original HSP/FSI changed?		
2.	Has a new subcontractor been added to the project?		
3.	Have additional tasks been added to the project which were not originally addressed in the plan?		
4.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
5.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in the plan?		

If the answer is "YES" to these questions, an HSP/FSI revision MAY BE NEEDED. Please contact HS&E directly.

1.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HS-55, *Subcontractor, Contractor, and Owner*)

Subcontractor: Ecology and Environment
Subcontractor Contact Name: Mark Longtine
Telephone: 206/624-9537
Subcontractor Task(s): Field Support

Safety Procedures Required: None (This subcontractor is covered by these FSI, and must comply with all requirements according to CH2M HILL standards.)

Subcontractor: Spokane Tribe of Indians
Subcontractor Contact Name: Brian Crossley
Telephone: 509/258-9217 Ext. 20
Subcontractor Task(s): Fishing boat and field support

Safety Procedures Required: Written safety procedures for boating operations and inspection checklists must be onsite during field activities.

The subcontractors listed above are covered by these FSI and must be provided a copy of this plan. However, these instructions do not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., boat operation and equipment usage, drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Signoff Form included in Attachment 1 to these FSI.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent noncompliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action—the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat noncompliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the PM and HSM as appropriate.
- Document all oral health and safety related communications in the project field notebook, daily reports, or other records.

2.0 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SC for clarification.

In addition to the basic training requirements for construction sites, the following specialty training is required:

- **Field Awareness Safety Training**—Onsite administrative support, sample preparation/packaging staff, and field operations support staff will be required to take this online course before conducting fieldwork on this project.
- **Fire Extinguisher**—The assigned SC onsite must take the online fire extinguisher training course.
- **Dangerous Goods Shipping**—The assigned SC onsite must take the online dangerous goods shipping (DGS) training course.
- **Bloodborne Pathogen Training**—The assigned SC onsite must take the online bloodborne pathogen training course.

2.1 Project-Specific Hazards

2.1.1 Working Above or Near Water

- Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jacket or buoyant work vests.
- Operate boat in accordance with all Coast Guard regulations.
- No alcoholic beverages permitted.
- Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects that would alter their strength or buoyancy. Defective units shall not be used.
- Use the checklist below.

Boater's Checklist		
	Yes	**No**
Personal Flotation Devices (PFDs)		
Visual Distress Signals		
Anchor and Anchor Line		
Sound-Producing Devices		
Navigation Lights and Shapes		
Fire Extinguishers		
Alternative Propulsion (e.g. paddles or skiff motor)		
Overall Vessel Condition Satisfactory		
Marine Sanitation Device		
Navigation Rules		
Ropes and Buoys		
First Aid Kit and Bloodborne Pathogen Kit		
Nonslip Deck		
Personnel Access Ladder		

2.1.2 Cold Stress

Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.

SYMPTOMS AND TREATMENT OF COLD STRESS

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Rewarm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

2.1.3 Heat Stress (Reference CH2M HILL SOP HS-09, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50 °F to 60 °F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SC to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny, raised, red, blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool, but **not** cold, water. Call ambulance, and get medical attention immediately.

2.1.4 Uneven Walking Surfaces

- Employees walking in ditches, swales, and other drainage structures adjacent to roads or across undeveloped land must use caution to prevent slips and falls that can result in twisted or sprained ankles, knees, and backs.
- Whenever possible, observe the conditions from a flat surface and do not enter a steep ditch or side of a steep road bed.
- If steep terrain must be negotiated, sturdy shoes or boots that provide ankle support should be used. The need for ladders or ropes to provide stability should be evaluated.
- Watch for icy conditions, and be aware of slips, trips, and falls.

2.1.5 Electrofishing/Gill Netting

- Use only boats designed for electrofishing.
- Boat electrofishing involves having high-voltage/low-amperage electricity discharged into the water to stun fish. The discharge is not constant. It is administered in short durations under the direction of the boat operator.
- Use only long-handle fiberglass pole nets to retrieve fish.
- Wear thick rubber-insulated gloves while using the nets.
- Wear rubber-insulated boots while on the boat.
- Boats must be equipped with high rails to prevent workers from falling in while netting fish.
- Boats must be equipped with "dead-man" switches that shut off the power to the electro-fishing equipment in case of an emergency. There are usually about six to nine switches on a boat, depending on their size. They are located all around the boat.
- When deploying and retrieving grill nets, ensure that personnel do not have on loose-fitting clothing, jewelry, or other items that may become entangled in nets. Personnel or boat operators should keep a knife onboard in the event of an emergency involving someone being caught in the netting.
- When initiating electrical shock to the water surrounding the vessel, ensure that no recreational boaters are in the general vicinity. If need be, wait until they leave the area or wave them off. If problems still persist, contact the National Park Service for assistance.

2.1.6 Burbot Trap Use

- Boats must be equipped with high rails to prevent workers from falling in while deploying and retrieving traps.
- Avoid strain on back and arms during deployment and recovery; use 2-man crews.
- When deploying and retrieving the traps, ensure that personnel do not wear loose-fitting clothing, jewelry, or other items that may become entangled in ropes. Personnel or boat operators should keep a knife onboard in the event of an emergency involving someone being caught up.

2.1.7 Outdoor Safety Tips

- When scheduling daily sampling events, always inform someone as to where you are going, your route, and when you expect to return. **Stick to your plan**.
- Carry enough water for each person, each day of your sampling trips (plastic gallon jugs are handy and portable).
- If caught in a storm, find shelter as soon as possible, and report your situation to the Field Team Leader.
- Report all incidents, no matter how minor, to your crew chief/lead, task manager, design manager, or PM as appropriate.

- Incident reports are required for all incidents.
- Two-track roads are inherently difficult; use caution.
- Pay attention, constantly observe the work area for hazards, and implement every effort needed to protect CH2M HILL personnel from onsite hazards.
- Carry emergency supplies of food, water, and clothing.

2.1.8 Field Vehicles

- Familiarize yourself with rental vehicle features:
  - Mirror and seat adjustments
  - Cruise control features
  - Pre-program radio stations
- Always wear seat belt while operating vehicle—drivers and passengers.
- Adjust headrest to proper position.
- Tie down loose items if using a van.
- Pull off the road, put the car in park, and turn on flashers before talking on a mobile phone.
- **Always obtain and maintain a field kit, consisting of a fire extinguisher, first aid kit, and flares.**
- Make a vehicle mechanical check and check fuel and fluid levels and tire condition.
- Carry a spare tire. Return to the field operations center immediately after replacing a flat.
- Close car doors slowly and carefully. Fingers can get pinched in doors or the car/ truck.
- Park in a manner that will allow for safe exit from vehicle and, where practicable, park the vehicle so that it can serve as a barrier.
- Operate the vehicle only when in possession of a valid driver's license.
- Always drive within the speed limit.
- Do not drive if you are fatigued.
- Use flashers/hazards when locating or stopping at work areas.
- Park in a manner that will allow for safe exit from vehicle.
- All staff working adjacent to a traveled way or within a work area must wear reflective/high-visibility safety vests.

2.1.9 Inclement Weather

- This project may be conducted during months of the year in which severe storms occur at a higher frequency and develop rapidly. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.
- Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (do not stand on a hilltop or stand under a lone tree; seek low areas); staying away from open water, metal equipment, wire fences, and metal pipes; and positioning people several yards apart.
- Remember that lightning may strike several miles from the parent cloud, so work should be stopped/restarted accordingly. If you feel your hair stand on end or smell ozone, lightning may be about to strike you. Immediately drop to your knees and bend forward—**do not** lie flat on the ground.
- High winds can cause unsafe surface water conditions, and sampling activities should be halted until wind dies down. High winds can also knock over trees, so walking through forested areas during high-wind situations should be avoided.

If winds increase, seek shelter or evacuate the area. Proper body protection should be worn in case the winds hit suddenly, because body temperature can decrease rapidly.

2.2 General Hazards

2.2.1 General Practices and Housekeeping (Reference CH2M HILL SOP HS-20, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

2.2.2 Manual Lifting (Reference CH2M HILL, SOP HS-29, *Lifting)*

Proper lifting techniques must be used when lifting any object, as follows:

- Plan storage and staging to minimize lifting or carrying distances.
- Split heavy loads into smaller loads.
- Use mechanical lifting aids whenever possible.
- Have someone assist with the lift, especially for heavy or awkward loads.
- Make sure the path of travel is clear prior to the lift.

2.2.3 Fire Prevention (Reference CH2M HILL, SOP HS-22, *Fire Prevention)*

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
  - be maintained in a fully charged and operable condition
  - be visually inspected each month
  - undergo a maintenance check each year
- The area in front of extinguishers must be kept clear.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.4 Electrical (Reference CH2M HILL, SOP HS-23, *Electrical)*

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.

- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
  - equipped with third-wire grounding
  - covered, elevated, or protected from damage when passing through work areas
  - protected from pinching if routed through doorways
  - not fastened with staples, hung from nails, or suspended with wire
- Electrical power tools and equipment must be effectively grounded or double-insulated Underwriters Laboratories (UL) approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

2.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks. If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

2.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.5 Bloodborne Pathogens (Reference CH2M HILL SOP HS-36, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

3.0 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HS-07, *Personal Protective Equipment and* HS-08, *Respiratory Protection*)

Note that PPE is required when exposed to the general hazards listed below. Because certain tasks (e.g., welding, energized work, etc.) require specialized PPE, refer to Section 2.0 for task-specific PPE requirements.

PPE Specifications [a]

Hazard	PPE
Energized equipment and environment when electrofishing	Fiberglass poles, insulated gloves, and insulated boots.
Severe cuts or lacerations, severe abrasions, punctures.	Leather work gloves (if necessary)
Inclement weather	Rain gear and cold weather gear
Working around heavy equipment or other noisy machinery, or if you must raise your voice to be heard while communicating with persons near you, hearing protection is required.	American National Standards Institute (ANSI) approved ear plugs or earmuffs.
Danger of foot injuries due to falling or rolling objects, objects piercing the sole, or when the feet are exposed to electrical hazards.	Sturdy footwear or ANSI approved steel-toed leather work boots.
Potential for head injury from impact, falling or flying objects.	ANSI approved hardhat.
Drowning	Coast Guard approved personal flotation device (life jacket)
Flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.	ANSI approved safety glasses with side shield, safety goggles, face shield, or welding glasses. Face shield may be used only in conjunction with the use of other protective eyewear.

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[b]	Downgrade
• Request from individual performing tasks.	• Situation is less hazardous than originally thought.
• Change in work tasks that will increase potential for injury.	• Change in site conditions that decreases the hazard.
• Known or suspected presence of dermal hazards.	• Change in work task that will reduce potential for injury.

[a] CH2M HILL will provide PPE only to CH2M HILL employees.

[b] Performing tasks that require respiratory protection is permitted only when the PPE requirements have been approved by the HSM, and an SC qualified at that level is present.

4.0 Emergency Response

(Reference CH2M HILL, SOP HS-12, *Emergency Response*)

4.1 Emergency Planning

Emergency Contacts

National Park Service
Monitors Marine-band Channel 16 (Can be used to contact NPS in the event of an emergency)

All CH2M HILL sampling vessels will remain on Channel 16 to monitor lake emergencies. In the event that nonemergency communication is necessary between vessels, the skipper or Field Team Leader will direct the desired vessel to switch to Channel 68.

Stevens County Dispatch – 509/684-2555
(from Hunters to Canadian Border)

In the event of an emergency, this number should also be used. The dispatcher will command emergency services to a proposed location with respect to your position on the lake. Maps are provided in your vessel kits to identify the rendezvous location

Lincoln County Dispatch – 509/725-3501
(from Hunters to Coulee Dam)

In the event of an emergency, this number should also be used. The dispatcher will command emergency services to a proposed location with respect to your position on the lake. Maps are provided in your vessel kits to identify the rendezvous location

Alternates
Spokane Tribe Fire Emergency – 509/258-4566
Colville Tribe Fire Emergency – 509/634-3100

Safety Coordinator (SC) and/or Sample Processing Station
Name: Shaun Roark/SEA

Will remain on Channel 16 to monitor lake emergencies. In the event that nonemergency communication is necessary between vessels and this station, this will be conducted on Channel 68.

Project Manager
Name: Jim Stefanoff/SPK or Chuck Gruenenfelder/SPK
Phone: 509/747-2000

Hospital Name/Address:	Mount Carmel Hospital 982 E. Columbia Street, COLVILLE, WA	**Hospital Phone #:** (509) 684-2561
	or	
	Lincoln Hospital 10 Nichols Street, Davenport, WA	**Hospital Phone #:** (509) 725-7101
	or	
	Coulee Community Hospital Address 411 Fortuyn Rd, Grand Coulee, WA	**Hospital Phone #:** (509) 633-1753

4.2 Emergency Equipment and Supplies

The SC should verify that these supplies are available, as needed, and in proper working order and mark the locations of emergency equipment on the site map, when a map is provided.

Emergency Equipment and Supplies	Location
20-lb (or two 10-lb) fire extinguisher (A, B, and C classes)	Required onboard boat
First aid kit	Required onboard boat
Bloodborne pathogen kit	Required onboard boat
Marine-band radio	Required onboard boat
Site map showing boat launches and vehicle access points	Required onboard boat

4.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Shut down CH2M HILL operations and evacuate the immediate area.
- Notify appropriate response personnel.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.

4.4 Evacuation Procedures

- Evacuation routes and assembly areas will be designated by the SC before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The SC and a "buddy" will remain on the site after the site has been evacuated (if safe) to inform local responders of the nature and location of the incident.
- The SC will account for all personnel at the assembly area.
- The SC will write up the incident as soon as possible after it occurs and submit a report to the Corporate Director of Health and Safety.

4.5 Emergency Medical Treatment

The procedures listed below may also be applied to nonemergency incidents. Injuries and illnesses (including overexposure to contaminants) must be reported to Human Resources. If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. During nonemergencies, follow these procedures as appropriate.

- Notify appropriate emergency response authorities listed in Attachment 2 of these FSI (e.g., 911).
- The SC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.
- Initiate first aid and cardiopulmonary resuscitation (CPR) where feasible.
- Get medical attention immediately.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.
- Report incident as outlined in Section 4.6.

4.6 Incident Notification and Reporting

- Upon any project incident (fire, spill, injury, near miss, death, etc.), immediately notify the PM and HSM. Call emergency beeper number if HSM is unavailable.
- For CH2M HILL work-related injuries or illnesses, contact and help Human Resources administrator complete an Incident Report Form (IRF). The IRF must be completed within 24 hours of an incident.
- For CH2M HILL subcontractor incidents, complete the Subcontractor Accident/Illness Report Form and submit to the HSM.
- Notify and submit reports to client as required in contract.

5.0 Approval

These FSI have been written for use by CH2M HILL and their subcontractors only. CH2M HILL claims no responsibility for their use by others unless that use has been specified and defined in project or contract documents. The FSI are written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

5.1 Original Plan

Written By: Mark Mullins/SEA **Date:** February 2005

Approved By: **Date: August 3, 2005**

John Culley/SPK

5.2 Revisions

Revisions Made By: **Date:**

Revisions to Plan:

Revisions Approved By: **Date:**

6.0 Attachments

Attachment 1: **Signoff Form – Field Safety Instructions**

Attachment 2: **Emergency Contacts**

FIELD SAFETY INSTRUCTIONS

Attachment 1. Signoff Form—Field Safety Instructions

CH2MHILL

SIGNOFF FORM

Field Safety Instructions

- The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this FSI, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:** 315904

NAME (Please print)	EMPLOYEE SIGNATURE	COMPANY	DATE

FIELD SAFETY INSTRUCTIONS

Attachment 2. Emergency Contacts

Emergency Contacts

24-hour CH2M HILL Emergency Beeper – 888/444-1226

Medical Emergency – 911
Facility Medical Response #:
Local Ambulance #:

CH2M HILL Medical Consultant
Health Resources
Dr. Jerry H. Berke, M.D., M.P.H.
600 West Cummings Park, Suite 3400
Woburn, MA 01801-6350
1-781-938-4653 1-800-350-4511
(After hours calls will be returned within 20 minutes)

Fire/Spill Emergency – 911
Facility Fire Response #:
Local Fire Dept #:

Local Occupational Physician

Security & Police – 911
Facility Security #:
Local Police #:

Corporate Director Health, Safety & Environment
Name: Jerry Lyle/BOI
Phone:
24-hour emergency beeper: 888-444-1226

Utilities Emergency
Water:
Gas:
Electric:

Regional Health & Safety Manager (HSM)
Name: John Culley/SPK
Phone: 509/747-2000 ext. 228
Cell: 206/660-3367

Safety Coordinator (SC)
Name: Shaun Roark/SEA
Phone: 425/453-5000

Regional Human Resources Department
Name: Linda Morrison/CVO
Phone: 541-752-4271

Project Manager
Name: Jim Stefanoff/SPK
Phone: 509/747-2000

Corporate Human Resources Department
Name: Pete Hannan/COR
Phone: 303/771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355
CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation:
Contact Regional HR dept. to have form completed or contact Julie Zimmerman after hours: 303/664-3304

AUTOMOBILE ACCIDENTS:
Rental: Carol Dietz/COR 303/713-2757
CH2M HILL owned vehicle:
Zurich Insurance Co. 800/987-3373

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms:

Evacuation Assembly Area(s):

Facility/Site Evacuation Route(s):

Hospital Name/Address: Mount Carmel Hospital
982 E. Columbia Street, Colville, WA
Hospital Phone #: (509) 684-2561

or

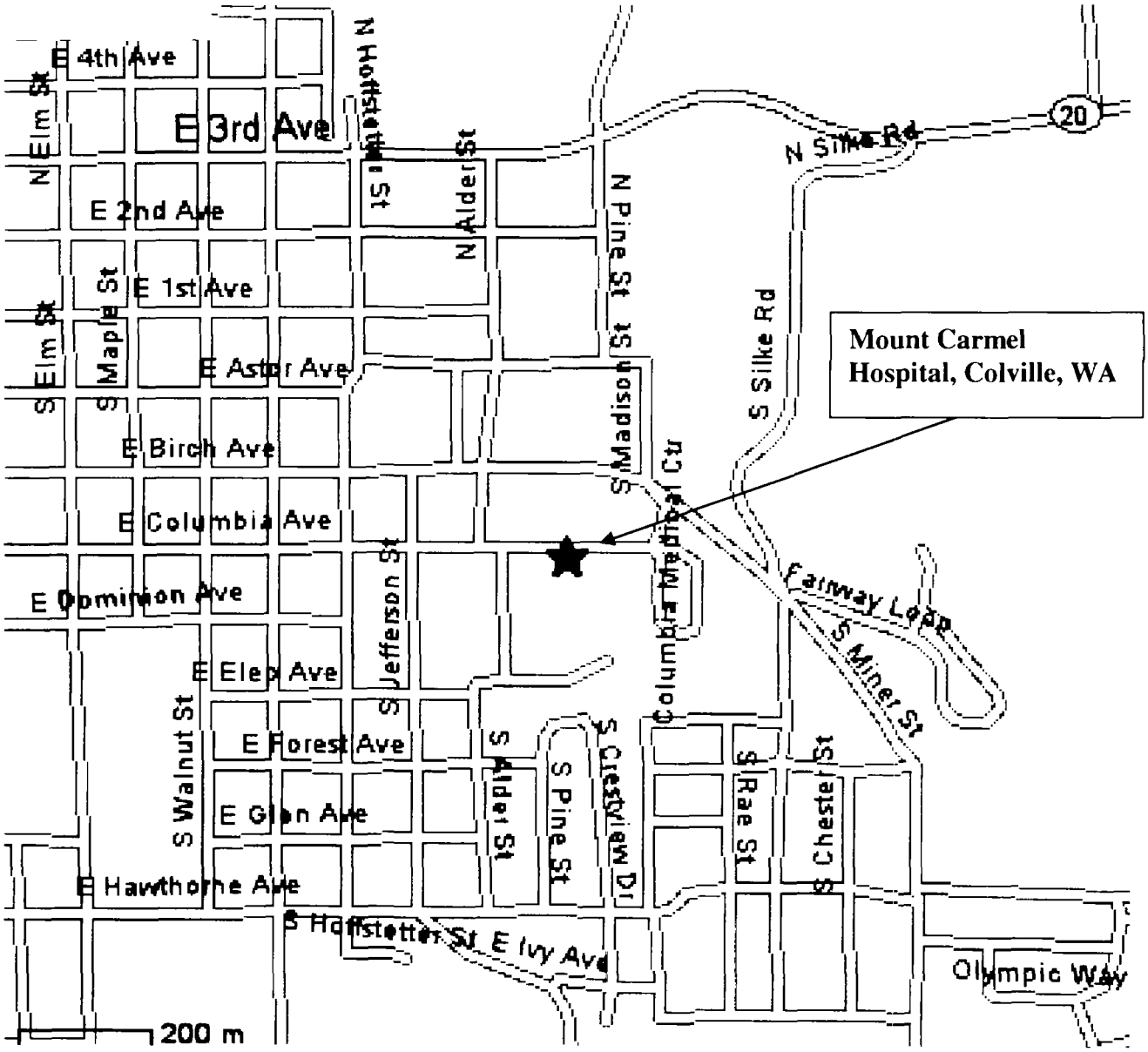
Lincoln Hospital
10 Nichols Street, Davenport, WA
Hospital Phone #: (509) 725-7101

or

Coulee Community Hospital
411 Fortuyn Rd, Grand Coulee, WA
Hospital Phone #: (509) 633-1753

Directions to Hospital

See maps next three pages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E 3rd Ave
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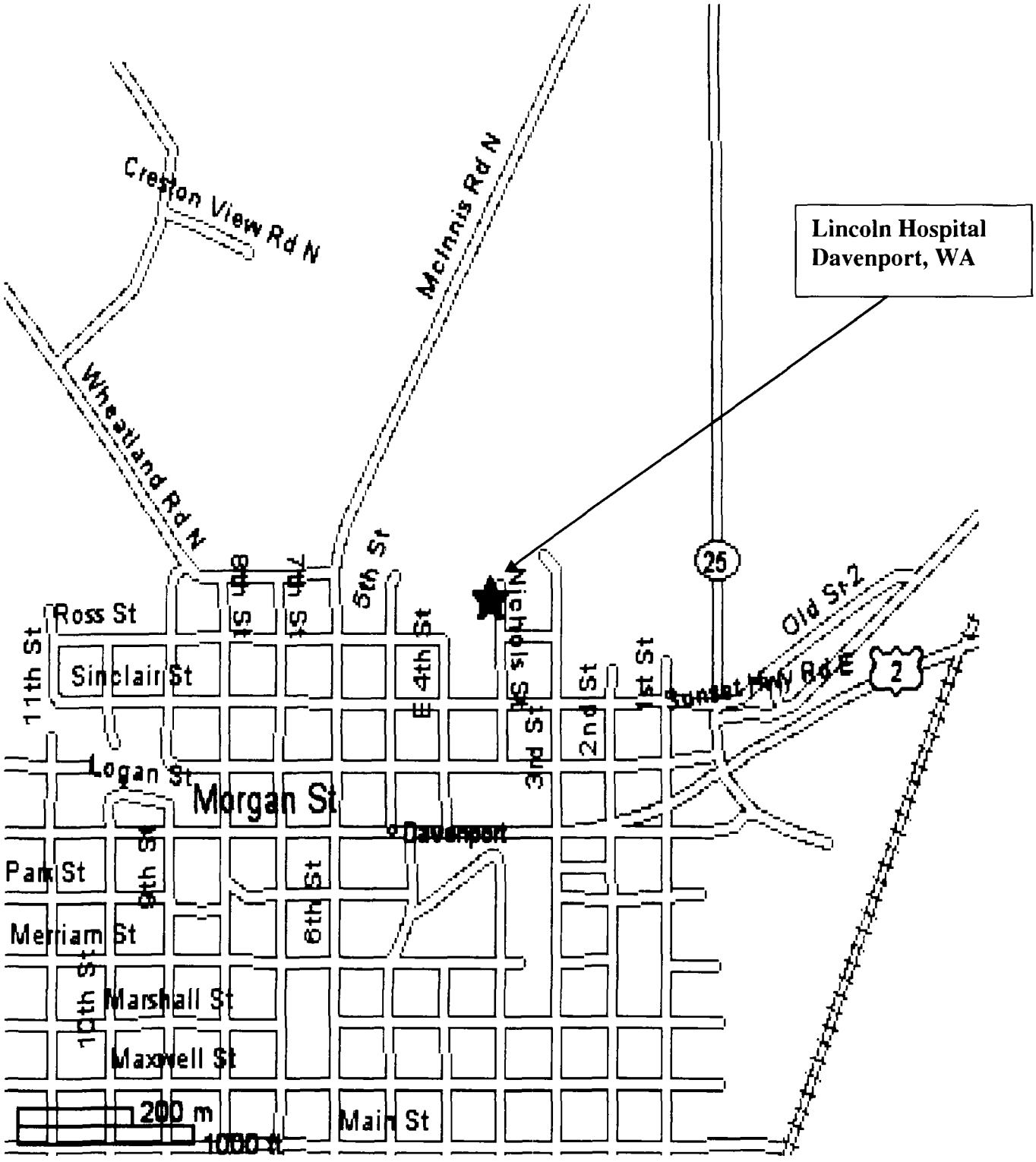
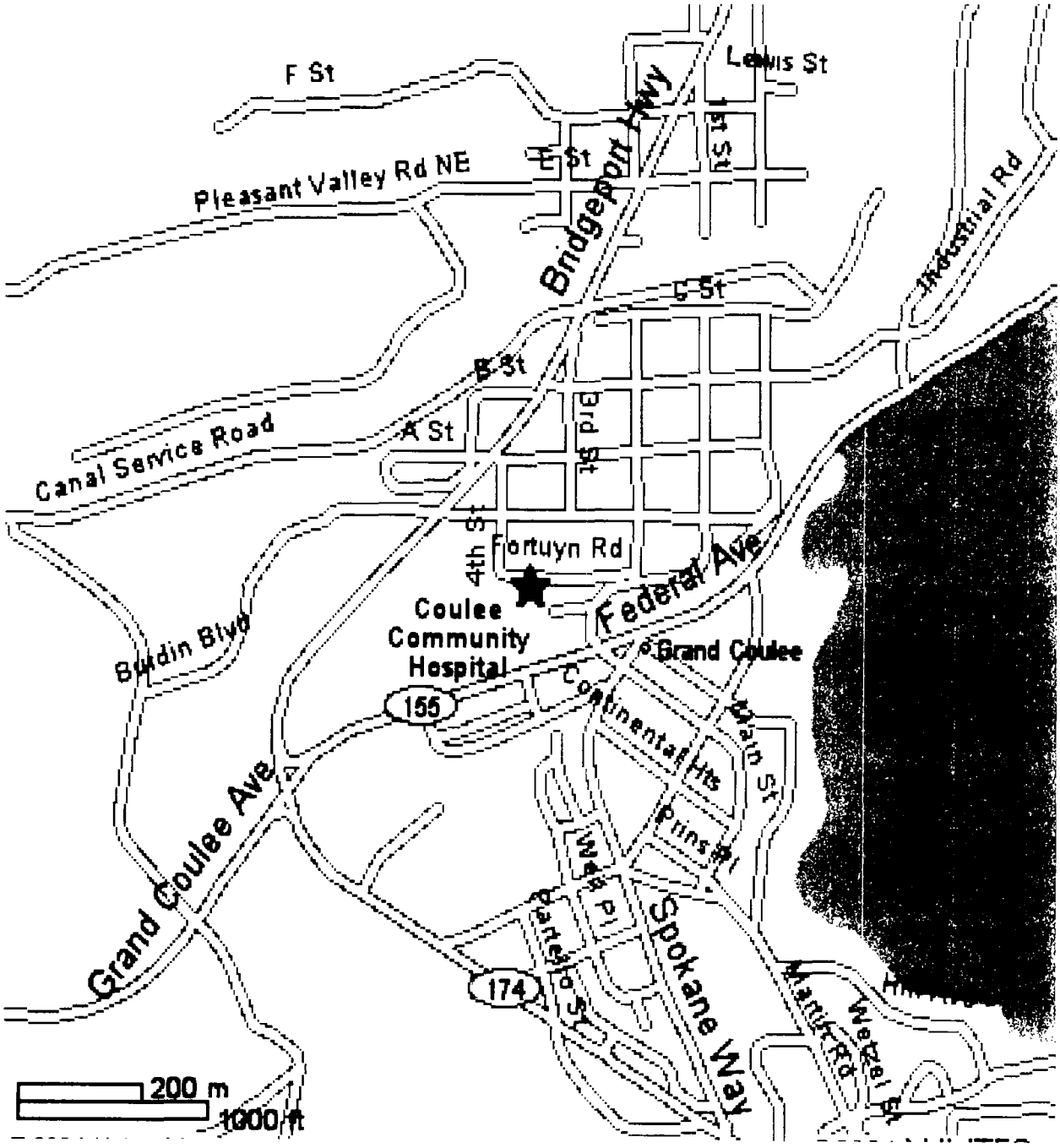
E Astor Ave
E Birch Ave
E Columbia Ave
E Dominion Ave
E Elep Ave
E Forest Ave
E Glen Ave
E Hawthorne Ave
S Hoffstetter St
E Ivy Ave
N Elm St
S Elm St
S Maple St
N Hoffstetter St
N Alder St
N Pine St
S Madison St
S Jefferson St
S Walnut St
S Alder St
S Pine St
S Crestview Dr
Columbia Medical Ctr
S Silke Rd
N Silke Rd
20
Fairway Loop
S Miner St
S Rae St
S Chester St
Olympic Way
Mount Carmel Hospital, Colville, WA
200 m



SEA/052420007



SEA/052420007

Appendix B
Forms

APPENDIX B

Forms

Fish Collection Form
Upper Columbia River Site RI/FS Fish Sampling – Phase I

FSCA _____ **Collection Date (MM/DD/YYYY): Start**_____ **End**_____

Gear Details: (circle one)

☐ E = Electrofishing	Run	1	2	3	4	5	6	_____
☐ N = Gillnetting	Net	1	2	3	4	5	6	_____
☐ T = Burbot Trap	Trap	1	2	3	4	5	6	_____

Sampling Information

Start Time : _____

Start Location:
Latitude (deg., min., sec.): _____ Longitude (deg., min., sec.): _____

End Time: _____

End Location:
Latitude (deg., min., sec.): _____ Longitude (deg., min., sec.): _____

Sampling depth: _____ Water depth (m): _____

Site Description:
_____
_____

Crew Information

Collectors' Names (print): _____

Field Team Leader (print and sign): _____

Notes and/or Sketch

Fish Collection Form Notes
Upper Columbia River site RI/FS Fish Sampling – Phase I

FSCA _____

Fish No.	Walleye Field Tag Number (e.g.: 0001)	Rainbow Trout Field Tag Number (e.g.: 0001)	Lake Whitefish Field Tag Number (e.g.: 0001)	Largescale Sucker Field Tag Number (e.g.: 0001)	Burbot Field Tag Number (e.g.: 0001)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Fish Processing Form
Upper Columbia River Site RI/FS Fish Sampling – Phase I

Composite Sample ID _____ Species Name: _____ FSCA: _____

Tissue Type: Whole Body ☐ Fillet ☐ Offal ☐

Number of Individuals: _____ Homogenization Date: _____

Fish	Fish Field Tag No.	Otoliths Removed (✓)	Total Weight of Homogenate (g)	Weight of Homogenate Used for Archive (g)	Weight of Homogenate Used for Composite (g)
1					
2					
3					
4					
5					
6					
7					
8					

Total Composite Weight (g) _____

Notes: _____

_____

_____

_____

SEA052420011

Length-Weight Form
Upper Columbia River Site RI/FS Fish Sampling – Phase I

FSCA _____ **Species** _____

Fish No.	Field Tag Number (e.g.: 0001)	Total Length (mm)*	Weight (g)	External Exam (✓)	Date	Time
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

*Minimum individual size should be no less than 75 percent of the maximum individual size.

Length-Weight Form
Upper Columbia River Site RI/FS Fish Sampling – Phase I

Notes:

FISH EXTERNAL EXAMINATION FORM

DATE:__/__/__ FSCA No._____ Fish Field Tag No. _____

Species: _____ Weight: _____(g) Length: _____(mm)

EXTERNAL EXAMINATION: *(check all that apply)*

BODY SURFACE:

- ☐ normal
- ☐ raised growth(s)
- ☐ reddened lesion(s)
- ☐ spinal deformities
- ☐ hemorrhagic body
- ☐ focal discoloration
- ☐ body fungus
- ☐ parasite(s) *(specify)*:
  - ☐ white spots
  - ☐ leech(es)
  - ☐ black spot(s)
  - ☐ Anchor worm(s)
- ☐ Other (*specify*):

_____

_____

HEAD and ORAL CAVITY:

- ☐ normal head
- ☐ deformed head
- ☐ upper lip growth
- ☐ lower lip growth
- ☐ swollen nare

BARBELS:

- ☐ normal
- ☐ missing
- ☐ stubbed
- ☐ deformed
- ☐ Other (*specify*):

_____

_____

EYES:

Left	Right
☐ normal	☐ normal
☐ exophalmic	☐ exophalmic
☐ opaque	☐ opaque
☐ missing	☐ missing
☐ hemorrhagic	☐ hemorrhagic
☐ emboli	☐ emboli
☐ Other (*specify*):	☐ Other (*specifiy*):
_____	_____
_____	_____

OPERCULA:

- ☐ normal
- ☐ slight shortening
- ☐ severe shortening
- ☐ Other (*specify*): _____

_____

_____

GILLS:

Left:	Right:
☐ normal	☐ normal
☐ frayed	☐ frayed
☐ marginate	☐ marginate
☐ pale	☐ pale
☐ Other (*specify*): _____	☐ Other (*specify*): _____

FINS:

- ☐ normal
- ☐ mild erosion
- ☐ severe erosion
- ☐ frayed
- ☐ hemorrhagic
- ☐ emboli

Other (*specify*): _____

_____

FIELD CHANGE REQUEST

Page ___ of ___ Field Change No.: _____ Project Number: _____

Project Name: _____

CHANGE REQUEST

Applicable
Reference: _____

Description of Change:

Reason for Change:

Impact on Present and Completed Work:

Requested by: _____ Date: _____
(FTL or SPC)

Acknowledged by: _____ Date: _____
(STL)

PROJECT MANAGER APPROVAL

Final Disposition:

Approved/Disapproved by: _____ Date: _____

US EPA TOPO APPROVAL

Approved/Disapproved by: _____ Date: _____

CORRECTIVE ACTION RECORD

Page ___ of ___ Audit Report No.: _____ Project Number: _____

Report Originator: _____

Person Responsible for Response: _____

DESCRIPTION OF PROBLEM:

Date and Time Problem Recognized: _____ By: _____

Date of Actual Occurrence: _____ By: _____

Analyte: _____ Analytical Method: _____

Cause of Problem:

CORRECTIVE ACTION PLANNED:

Person Responsible For Corrective Action: _____ Date of Corrective Action: _____

Corrective Action Plan Approval: _____ Date: _____

DESCRIPTION OF FOLLOWUP ACTIVITIES:

Person Responsible for Followup Activities: _____ Date of Followup Activity: _____

Final Corrective Action Approval: _____ Date: _____

USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

Case No:	39563
DAS No:	DAS34
SDG No:	L

Date Shipped:	03/28/2005
Carrier Name:	FedEx
Airbill:	123456789
Shipped to:	A4 Scientific, Inc. 1544 Sawdust Road Suite 505 The Woodlands TX 77380 (281) 292-5277

Chain of Custody Record

Relinquished By	(Date / Time)	Received By	(Date / Time)
1			
2			
3			
4			

Sampler Signature:

For Lab Use Only

Lab Contract No:
Unit Price:
Transfer To:
Lab Contract No:
Unit Price:

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	FOR LAB USE ONLY Sample Condition On Receipt
MJ0004	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	147 (1)	LS01W0105	S: 03/28/2005	15:10		
MJ0005	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	152 (1)	RB01F0105	S: 03/28/2005	15:30		
MJ0006	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	154 (1)	RB01F0205	S: 03/28/2005	15:30		
MJ0007	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	156 (1)	WE01F0105	S: 03/28/2005	14:55		
MJ0008	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	158 (1)	WE01F0205	S: 03/28/2005	14:55		
MJ0009	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	160 (1)	WF01W0105	S: 03/28/2005	15:50		
MJ0010	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	162 (1)	WF01W0205	S: 03/28/2005	15:50		
MJ0011	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	164 (1)	WF01W0305	S: 03/28/2005	15:50		
MJ0012	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	166 (1)	LS01W0205	S: 03/28/2005	15:10		

Shipment for Case Complete?N	Sample(s) to be used for laboratory QC:	Additional Sampler Signature(s):	Cooler Temperature Upon Receipt:	Chain of Custody Seal Number:
Analysis Key:	Concentration: L = Low, M = Low/Medium, H = High	Type/Designate: Composite = C, Grab = G	Custody Seal Intact? ___	Shipment Iced? ___

As = Arsenic, TM = CLP TAL Total Metals

TR Number: 10-042025758-032805-0002

LABORATORY COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

USEPA Contract Laboratory Program
Generic Chain of Custody

Reference Case 39563
Client No: DAS34
SDG No:

L

Date Shipped:	03/28/2005
Carrier Name:	FedEx
Airbill:	123456789
Shipped to:	A4 Scientific, Inc. 1544 Sawdust Road Suite 505 The Woodlands TX 77380 (281) 292-5277

Chain of Custody Record

Relinquished By	(Date / Time)	Received By	(Date / Time)
1			
2			
3			
4			

Sampler Signature:

For Lab Use Only

Lab Contract No:
Unit Price:
Transfer To:
Lab Contract No:
Unit Price:

SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		FOR LAB USE ONLY Sample Condition On Receipt
LS01W0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	149 (1)	LS01W0105	S: 03/28/2005	15:10	
LS01W0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	167 (1)	LS01W0205	S: 03/28/2005	15:10	
RB01F0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	153 (1)	RB01F0105	S: 03/28/2005	15:30	
RB01F0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	155 (1)	RB01F0205	S: 03/28/2005	15:30	
WE01F0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	157 (1)	WE01F0105	S: 03/28/2005	14:55	
WE01F0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	159 (1)	WE01F0205	S: 03/28/2005	14:55	
WF01W0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	161 (1)	WF01W0105	S: 03/28/2005	15:50	
WF01W0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	163 (1)	WF01W0205	S: 03/28/2005	15:50	
WF01W0305	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	165 (1)	WF01W0305	S: 03/28/2005	15:50	

Shipment for Case Complete?N	Sample(s) to be used for laboratory QC:	Additional Sampler Signature(s):	Cooler Temperature Upon Receipt:	Chain of Custody Seal Number:	
Analysis Key:	Concentration: L = Low, M = Low/Medium, H = High	Type/Designate: Composite = C, Grab = G		Custody Seal Intact? ___	Shipment Iced? ___

PCB = PCBs (AROCLORS), PCB_C = PCBs (CONGENERS), PCDD = Dioxins and Furans

TR Number: 10-042025758-032805-0001

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USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

Case No:	39563
DAS No:	DAS34

R

Region:	10
Project Code:	QW-123
Account Code:	ACCT000
CERCLIS ID:	
Spill ID:	ID3
Site Name/State:	EXAMPLE SITE/WA
Project Leader:	JOHN SAMPLER
Action:	Remedial Investigation
Sampling Co:	SMITH CO.

Date Shipped:	03/28/2005
Carrier Name:	FedEx
Airbill:	123456789
Shipped to:	A4 Scientific, Inc. 1544 Sawdust Road Suite 505 The Woodlands TX 77380 (281) 292-5277

Chain of Custody Record

Relinquished By	(Date / Time)	Received By	(Date / Time)
1			
2			
3			
4			

Sampler Signature:

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME	ORGANIC SAMPLE No.	QC Type
MJ0004	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	147 (1)	LS01W0105	S: 03/28/2005 15:10		--
MJ0005	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	152 (1)	RB01F0105	S: 03/28/2005 15:30		--
MJ0006	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	154 (1)	RB01F0205	S: 03/28/2005 15:30		--
MJ0007	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	156 (1)	WE01F0105	S: 03/28/2005 14:55		--
MJ0008	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	158 (1)	WE01F0205	S: 03/28/2005 14:55		--
MJ0009	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	160 (1)	WF01W0105	S: 03/28/2005 15:50		--
MJ0010	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	162 (1)	WF01W0205	S: 03/28/2005 15:50		--
MJ0011	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	164 (1)	WF01W0305	S: 03/28/2005 15:50		--
MJ0012	Fish/ JOE SAMPLER	L/C	As (21), TM (21)	166 (1)	LS01W0205	S: 03/28/2005 15:10		--

Shipment for Case Complete? N	Sample(s) to be used for laboratory QC:	Additional Sampler Signature(s):	Chain of Custody Seal Number:
Analysis Key:	Concentration: L = Low, M = Low/Medium, H = High	Type/Designate: Composite = C, Grab = G	Shipment Iced? _____
As = Arsenic, TM = CLP TAL Total Metals			

TR Number: 10-042025758-032805-0002

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EPA USEPA Contract Laboratory Program
Generic Chain of Custody

Reference Case: 39563 R
Client No: DAS34

Region:	10	**Date Shipped:**	03/28/2005	**Chain of Custody Record**	**Sampler Signature:**
Project Code:	QW-123	**Carrier Name:**	FedEx	**Relinquished By (Date / Time)**	**Received By (Date / Time)**
Account Code:	ACCT000	**Airbill:**	123456789	1	
CERCLIS ID:		**Shipped to:**	A4 Scientific, Inc. 1544 Sawdust Road Suite 505 The Woodlands TX 77380 (281) 292-5277	2	
Spill ID:	ID3			3	
Site Name/State:	EXAMPLE SITE/WA			4	
Project Leader:	JOHN SAMPLER				
Action:	Remedial Investigation				
Sampling Co:	SMITH CO.				

SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME	QC Type
LS01W0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	149 (1)	LS01W0105	S: 03/28/2005 15:10	--
LS01W0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	167 (1)	LS01W0205	S: 03/28/2005 15:10	--
RB01F0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	153 (1)	RB01F0105	S: 03/28/2005 15:30	--
RB01F0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	155 (1)	RB01F0205	S: 03/28/2005 15:30	--
WE01F0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	157 (1)	WE01F0105	S: 03/28/2005 14:55	--
WE01F0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	159 (1)	WE01F0205	S: 03/28/2005 14:55	--
WF01W0105	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	161 (1)	WF01W0105	S: 03/28/2005 15:50	--
WF01W0205	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	163 (1)	WF01W0205	S: 03/28/2005 15:50	--
WF01W0305	Fish/ JOE SAMPLER	L/C	PCB (21), PCB_C (21), PCDD (21)	165 (1)	WF01W0305	S: 03/28/2005 15:50	--

Shipment for Case Complete? N	Sample(s) to be used for laboratory QC:	Additional Sampler Signature(s):	Chain of Custody Seal Number:
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G	**Shipment Iced?** _____
PCB = PCBs (AROCLORS), PCB_C = PCBs (CONGENERS), PCDD = Dioxins and Furans			

TR Number: 10-042025758-032805-0001

REGION COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.

Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819, Phone 703/818-4200; Fax 703/818-4602

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: LS01W0105
Station Loc: LS01W0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:10

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0004
Station Loc: LS01W0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:10

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: LS01W0205
Station Loc: LS01W0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:10

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0012
Station Loc: LS01W0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:10

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0005
Station Loc: RB01F0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:30

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: RB01F0105
Station Loc: RB01F0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:30

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0006
Station Loc: RB01F0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:30

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: RB01F0205
Station Loc: RB01F0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:30

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0007
Station Loc: WE01F0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 14:55

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: WE01F0105
Station Loc: WE01F0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 14:55

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0008
Station Loc: WE01F0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 14:55

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: WE01F0205
Station Loc: WE01F0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 14:55

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0009
Station Loc: WF01W0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:50

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: WF01W0105
Station Loc: WF01W0105 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:50

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0010
Station Loc: WF01W0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:50

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: WF01W0205
Station Loc: WF01W0205 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:50

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: MJ0011
Station Loc: WF01W0305 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:50

Project No: QW-123 Case No:39563
Station No: Fish Collection Area 1 Sample No: WF01W0305
Station Loc: WF01W0305 Designate: Comp
Sampling Date/Time: 03/28/2005 / 15:50

Appendix C
Standards of Practice

APPENDIX C

Standards of Practice

STANDARD OF PRACTICE FISHQAPP-1

Fish Collection, September 2005

Purpose

The purpose of this standard of practice (SOP) is to describe procedures for collecting fish using gill nets and electrofishing during September 2005 for the Upper Columbia River (UCR) Remedial Investigation/Feasibility Study (RI/FS).

Scope and Applicability

This procedure applies to fish collection on the UCR in September 2005, which will be the first of two fish collection stages. This first sampling stage will primarily target lake whitefish, and the second stage (to be conducted in October 2005) will target the remaining species to be collected. The September collection method will consist of two boat crews operating gill nets, supplemented by electrofishing where necessary. The goal of this sampling effort is to collect 25 individual whitefish at each of six Fish Sampling Collection Areas (FSCAs). Because the sampling methods to be used are not species-specific, additional target species captured may also be collected. The remaining target species will be collected during the October 2005 sampling stage (see SOP FISHQAPP-2).

Equipment and Materials

- 12 gill nets (200 x 10 feet [ft], 3- and 4-inch [stretch] mesh)
- Anchors (20 to 30 pounds [lb], 2 per net)
- Buoys (16-inch diameter or similar, 2 per net)
- Carabiners or clips for connecting float lines and anchors (up to 8 per net)
- Tub or live well on board vessel for holding live fish (minimum of one per vessel)
- Coolers with ice (one cooler per vessel for each target species)
- Fish clubs
- Measuring boards
- Boats equipped for gill netting and/or electrofishing as required for 2 crews
- Dip nets (2 per electrofishing vessel)
- Rubber deck boots
- Disposable gloves for removing fish from nets
- Disposable nitrile gloves for handling and tagging fish
- Personal flotation devices
- Radios
- Global positioning system (GPS) receivers
- Depth finder
- Knife (1 per crew)
- Maps

- Fish tags and cable ties
- Field forms and notebooks
- Pens and pencils

Typical Procedures and Guidelines

The procedures for fish collection will vary by FSCA. At FSCAs 4 through 6, which are located downstream, it is anticipated that all whitefish will be collected using gill nets. At FSCAs 2 and 3, current and available habitat may necessitate the use of both gillnetting and electrofishing to complete the whitefish collection. At FSCA 1, where suitable gillnetting locations are limited due to current and shoreline characteristics, electrofishing will be the only feasible sampling method within the FSCA. Gill nets will be set outside FSCA 1 about 2.5 miles downstream from the downstream boundary of the FSCA in Deadman's Eddy, where the current is slow enough to allow net placement.

If inadequate numbers of fish of some or all species have been collected from a specific target FSCA after following the procedures described below, the STL will consult with the Project Manager (PM), Task Order Project Officer (TOPO), and/or Quality Assurance Officer (QAO) to determine whether additional time should be spent trying to obtain additional fish samples from these locations, or whether locations outside the FSCA should be sampled.

Gillnetting

The number of gill net sets in an FSCA during a single day will be determined by available habitat and the feasibility of setting nets in that FSCA. At downstream FSCAs (3 through 6), it is likely that all six nets will be set daily by each boat crew.

Gill net sets for lake whitefish will generally be deep (e.g., 60 to 80 meters) and will be set on or near the bottom. Adjustments to depth will be made at the direction of the Field Team Leader (FTL) and in consultation with local fisheries biologists. Procedures for gill net deployment and retrieval are as follows:

- Gill Net Deployment

    1. Arrive at a selected boat ramp near the target FSCA.
    2. Mobilize sampling gear and vessels.
    3. Decontaminate sampling equipment and fish holding containers by rinsing with lake water.
    4. Review sampling objectives for the day.
    5. Travel to the target FSCA.
    6. Identify sample locations at the target FSCA. Potential sampling locations may have been identified previously during site visits and/or conversations with biologists familiar with this species and collection area. Final selection of collection locations will be at the discretion of the FTL and will be based on factors such as safety, wind, current, depth, and habitat suitability.

7. Deploy up to six gill nets within the FSCA. Gill nets will generally be set in the afternoon or early evening, and pulled out the following morning. Weather conditions and coordination with other boat crews and onshore teams may necessitate alternatives, but the FTL should avoid leaving nets unchecked for more than 24 hours.

   Record GPS coordinates, date, and time on the fish collection form (FCF; see Appendix B) for each gill net set.

- Gill Net Retrieval

1. Follow Steps 1 through 5 in Gill Net Deployment, above.
2. Retrieve the gill net at each sampling location. Record date and time on the FCF.
3. As the net is pulled into the boat, remove nontarget species and target species outside the target size ranges. If the fish are alive, return them to the water. Otherwise, fish carcasses will be disposed of by puncturing the swim bladder and returning them to the water.
4. All whitefish of the target size range (13 to 17 inches) will be placed in a holding container (either a large tub of water or a live-well if alive, or a cooler if dead) until all fish in the gill net have been removed. Adjustments to the target size range may be made as necessary by the FTL after consultation with the Sampling Team Leader (STL). Other target species will be kept if approximately five or more individuals are collected from the FSCA. Collection of target species other than whitefish will be at the discretion of the FTL.
5. After all fish from the net are removed, target fish will be euthanized with a club or mallet (which will be decontaminated between fish by rinsing in lake water), a field label will be attached to the fish, and the fish will be placed in a cooler on ice. The field label will consist of a numbered plastic tag that will be attached to the fish through the mouth and opercula with a cable tie.
6. The tag numbers for all fish collected from each net will be recorded on the FCF associated with the collection location. Tags will be pre-numbered with sequential 4-digit numbers as described in QAPP Section 3.2.1.4.
7. After pulling all gill nets, the FTL will count the total number of lake whitefish collected in the FSCA and proceed as follows:

   a. If the target number was collected, the whitefish collection at the site will be considered complete, and additional gill nets will not be set for whitefish in the FSCA.

   b. If the number of fish collected is less than the target number, but catch rates are high enough that 2 additional nights are likely to capture the target number of fish, the nets will be reset in approximately the same locations.

   c. If no fish or very few fish were collected during the first gill net set, the FTL will consult with the STL before resetting nets.

8. At the end of each day, decontaminate live wells and dip nets by thoroughly rinsing in lake water, and collect 5 to 10 gallons of lake water to be returned to the onshore processing station for rinsing fish and equipment.

9. Return to the boat ramp and deliver the fish and rinse water to the onshore processing station. The FTL or the SPC will sign the chain-of-custody forms before the samples are shipped to the offsite processing laboratory.

10. Fish collected in the gill nets will be returned to the onshore sample processing station in coolers clearly labeled with the species and FSCA. Depending on the proximity of the FSCA to the onshore station and the availability of the onshore processing station, the fish may be returned for processing either before or after resetting the gill nets and/or electrofishing..

Electrofishing

The following procedures will be used for electrofishing:

1. Prepare vessel for electrofishing by deploying the anodes.

2. Record GPS coordinates, time, and date on the FCF at start of the electrofishing transect.

3. Navigate the vessel through the littoral habitat, electrofishing with a current of approximately 5 amperes.

4. Collect stunned fish of the target species and target size range with dip nets.

5. Place stunned fish in the designated cooler or live-well. All target species may be placed in a single live-well or cooler; sorting will occur after the electrofishing transect has been completed.

6. Record GPS coordinates at the end of the electrofishing transect. If the targeted number of whitefish is not collected, repeat Steps 1 to 5 at another location within the FCSA.

7. Following electrofishing at all locations, sort, recheck for target size, euthanize, and label the fish as described for gillnetting above. Place the tagged fish in labeled coolers for transport to the onshore processing station

8. Return to the boat ramp and the deliver fish to the sample processing station. The FTL or SPC will sign the chain of custody form prior to shipping samples to the homogenization lab.

9. At the end of each day, decontaminate live wells and dip nets by thoroughly rinsing in lake water, and collect 5 to 10 gallons of lake water to be returned to the onshore processing station for rinsing fish and equipment.

STANDARD OF PRACTICE FISHQAPP-2

Fish Collection, October 2005

Purpose

The purpose of this standard of practice (SOP) is to describe procedures for collecting fish using gill nets and electrofishing during October 2005 for the Upper Columbia River (UCR) Remedial Investigation/Feasibility Study (RI/FS).

Scope and Applicability

This procedure applies to fish collection in the UCR in October 2005, which is the second of two sampling stages. The first stage will occur in September 2005 and will target lake whitefish (see SOP FISHQAPP-1). The October effort will involve two boat crews gillnetting and electrofishing for rainbow trout, walleye, and largescale suckers. A third boat crew will focus on the use of baited traps to collect burbot as well as gillnetting for all target species. The goal of the October effort is to complete the collection of target-length individuals of each species within each FSCA. The target number of individuals of each target species to be collected during September and October combined is 25.

Equipment and Materials

- 12 gill nets (200 x 10 feet [ft], 3- and 4-inch [stretch] mesh)
- Anchors (20 to 30 pounds [lb], 2 per net)
- Buoys (16-inch diameter or similar, 2 per net and 1 per burbot trap)
- Carabiners or clips for connecting float lines and anchors (up to 8 per net)
- Tub or live well on board vessel for holding live fish (minimum of one per vessel)
- Coolers with ice (one cooler per vessel for each target species)
- Fish clubs
- Measuring boards
- Boats equipped for electrofishing and/or gill netting as needed for 3 crews
- Dip nets (2 per electrofishing vessel)
- Rubber deck boots
- Disposable gloves for removing fish from nets
- Disposable nitrile gloves for handling and tagging fish
- Burbot traps and bait
- Personal flotation devices
- Radios
- Global positioning system (GPS) receivers
- Depth finder
- Knife (1 per crew)
- Maps

- Fish tags and cable ties
- Field forms and notebooks
- Pens and pencils

Typical Procedures and Guidelines

The procedure described below involves three crews employing all methods (electrofishing, gill nets, and burbot traps) each day for 3 days per FSCA. However, because of travel time and logistical constraints, it may be impractical or impossible for a single crew to employ multiple collection methods in a single day at every FSCA. In addition, some methods may be impractical or unproductive in certain collection areas. Therefore, final decisions on methods to be used each day will be made by the Field Team Leaders (FTLs) and Sampling Team Leader (STL).

If inadequate numbers of fish of some or all species have been collected from a specific target FSCA after following the procedures described below, the STL will consult with the Project Manager (PM), Task Order Project Officer (TOPO), and/or Quality Assurance Officer (QAO) to determine whether additional time or collection methods (i.e. angling) should be spent trying to obtain additional fish samples from these locations, or whether locations outside the FSCA should be sampled.

Day 1. Gill Nets, Burbot Traps, and Electrofishing

1. Arrive at a selected boat ramp nearest to the target FSCA.
2. Mobilize sampling gear and vessels.
3. Decontaminate sampling equipment and fish holding containers by rinsing in lake water.
4. Review sampling objectives for the day.
5. Travel to the target FSCA.
6. Identify sample locations at the target FSCA. Potential sampling locations may have been identified previously during site visits and/or conversations with biologists familiar with this species and collection area. Final collection locations will be at the discretion of the FTL (safety, wind, current, depth).
7. Deploy gill nets (as necessary) and record GPS coordinates, date, and time for each net set on a separate fish collection form (FCF; see Appendix B). Each of the three sample crews will deploy approximately four gill nets. Gill nets will generally be set in the afternoon or early evening, and pulled out the following morning. Weather conditions and coordination with other boat crews and onshore teams may necessitate alternatives, but the FTL should avoid leaving nets unchecked for more than 24 hours.

   The number of gill nets set in an FSCA during a single day will be determined by the available habitat and feasibility of setting nets in the FSCA. At downstream FSCAs, it is likely that 12 nets will be set daily. At upstream sites, where suitable locations will be limited, it is likely that fewer nets will be set simultaneously.

8. One sample crew deploy burbot traps (as necessary) and record GPS coordinates, date, and time on a separate FCF for each trap.
   - Place bait (e.g., dead fish) in burbot trap and attach rope and float
   - Lower trap to bottom
   - Record date, time, and GPS coordinates on a separate FCF for each trap
9. The remaining two sample crews prepare the vessels for electrofishing.
10. Conduct electrofishing at the first sampling location, as follows:
    - Record GPS coordinates, date, and time on the FCF at the start of the electrofishing transect.
    - Deploy anode and navigate the vessel through littoral habitat, electrofishing with approximately 5 amperes.
    - Collect stunned fish of the target species and target size range with dip nets (target size for all species (except burbot) is 13 to 17 inches; target size for burbot is 17 to 22 inches). Unless the STL has indicated that additional whitefish need to be collected at an FSCA, whitefish will not be collected. Avoid collection of nontarget species.
    - Place stunned fish in designated cooler or live well.
    - Record GPS coordinates at the end of the electrofishing transect.
11. Move to second sampling location and repeat the electrofishing procedure if needed. A separate FCF will be used for each electrofishing transect or location.
12. Move to additional sampling locations and repeat electrofishing procedure if needed. Sampling crews will remain in periodic contact to avoid collecting more than the target number of fish.
13. Following electrofishing, don a clean pair of disposable gloves (for each FSCA), sort fish according to species, recheck for target size, euthanize using a club, and tag the fish using a pre-numbered plastic tag (see QAPP Section 3.2.1.4) and plastic cable tie attached through the gill and opercula. Record the tag number on the FCF under the appropriate species heading.
14. Place the tagged fish on ice in coolers labeled according to FSCA and species for transport to the onshore sample processing station.
15. When sampling is finished, the sampling equipment (e.g., dip nets, lives wells, coolers) will be decontaminated by rinsing in lake water.
16. Additional water (5 to 10 gallons) will be collected away from shore at each FSCA to be used for rinsing fish and equipment at the onshore processing station.
17. Return to the boat ramp and deliver the fish and rinse water to the onshore processing station. The FTL or the SPC will sign the chain-of-custody forms before the samples are shipped to the offsite processing laboratory.

Day 2. Gill Nets, Burbot Traps, and Electrofishing

1. Return to and mobilize vessels the following morning to retrieve gill nets and/or burbot traps.
2. Travel to the target FSCA.
3. Retrieve gill nets at sampling locations.
4. Remove captured fish and sort by target species and size and sort for bycatch.
5. Return nontarget species and unusable target species to the water.
6. Retrieve burbot traps at first sampling locations.
7. Remove nontarget species and burbot of nontarget size ranges as quickly as possible and return to water if alive.
8. Following retrieval of gill nets and burbot traps, sort and label fish as described in Step 13, above, and place labeled fish on ice in coolers for transport to the onshore processing station.
9. Gill nets may be reset immediately if the STL and FTLs determine it is necessary. Gill nets may also be reset later in the day.
10. Electrofish using process described in Steps 10 to 14 for Day 1.
11. When sampling is finished, the sampling equipment (e.g., dip nets, lives wells, coolers) will be decontaminated by rinsing in lake water.
12. Additional water (5 to 10 gallons) will be collected away from shore at each FSCA to be used for rinsing fish and equipment at the onshore processing station.
13. All crews return to the boat ramp and deliver the fish to the onshore processing station. The FTL or the SPC will sign the chain-of-custody forms before the samples are shipped to the offsite processing laboratory.

Day 3 (required if additional fish collection is necessary)

1. Travel to target FSCA.
2. Retrieve gill nets set the previous day.
3. Remove captured fish and sort by target species and size, and sort out nontarget species.
4. Return nontarget species and unusable target species to the water. Dispose of as dead fish by puncturing the swim bladder and returning fish to the water.
5. Following retrieval of gill nets at all locations, sort and label fish as described in Day 1, Step 13, above, and place labeled fish in coolers for transport to the onshore processing station.
6. The FTLs and STL will confer to determine whether additional collections are necessary.
7. When sampling is finished, the sampling equipment (e.g., dip nets, lives wells, coolers) will be decontaminated by rinsing in lake water.

8. Additional water (5 to 10 gallons) will be collected away from shore at each FSCA to be used for rinsing fish and equipment at the onshore processing station.
9. Transport samples to the onshore processing station. The FTL or the SPC will sign the chain-of-custody forms before the samples are shipped to the offsite processing laboratory.

STANDARD OF PRACTICE FISHQAPP-3

Onshore Sample Processing

Purpose

The purpose of this standard of practice (SOP) is to describe the procedures used for measuring fish length and weight and performing the external examination of fish collected during September and October 2005 for the Upper Columbia River (UCR) Remedial Investigation/Feasibility Study (RI/FS).

Scope and Applicability

This standard of practice applies to all species of fish collected during both the September and October stages of sampling.

Equipment List

- Freezers and thermometers
- Balance and calibration weight
- Measuring board
- Examination board (such as a plastic cutting board or stainless steel pan or tray)
- Nitrile gloves
- Heavy-duty aluminum foil
- Tubular, 4-mil, low-density polyethylene (LDPE), Food and Drug Administration (FDA)-approved plastic bags
- Cable ties
- Sprayer containing lake water for rinsing equipment
- Forms: length-weight form (LWF) and fish external examination form
- Secondary field tags
- Office supplies including computer(s), printer, a file cabinet, pens and pencils
- Marine band radio and cell phone

Typical Procedures and Guidelines

The measurement and external examination of fish will be performed in a construction trailer located in a recreational vehicle (RV) site at the Kettle Falls Marina. The trailer will remain at the Kettle Falls Marina for the duration of the fish sampling and will serve as a communications center, field office and fish measurement and examination station.

The trailer will be divided into an office section and a working section. The office will be equipped with a computer, printer/fax machine, file cabinets, general office supplies, and necessary radio communications equipment to contact the personnel on board the sampling vessels. The work area will have a large roll-up door for access and ventilation. The work

area will be lined with plastic to keep the walls and floor clean and will contain two freezers, work tables/benches, the measuring equipment, and space for examining the fish. Additional equipment storage will be available in a large panel truck, also located at the Kettle Falls Marina.

The onshore personnel (or crew) will be available to assist the fish sampling crews as necessary, including traveling to boat launch sites to collect fish from the fish sampling crews.

Fish Processing

Following are procedures to be used for fish processing at the onshore station. Fish will generally be measured and examined on the same day they are collected. Fish collected by electrofishing at night may be measured and examined the following day. Fish will be measured, examined, and frozen within 24 hours of collection.

1. Receive fish from field sample crew. Fish will be on ice in coolers, sorted by Fish Sampling Collection Area (FSCA) and species. Check that coolers are clearly labeled in accordance with the specifications in QAPP Section 3.3.1.2 and that ice in coolers is adequate to keep fish cold until measurement and examination is complete. The Field Team Leader (FTL) and Sample Processing Coordinator (SPC) will sign chain-of-custody forms prior to shipping the fish to the offsite processing laboratory.

2. Wear nitrile gloves when handling fish. Clean gloves should be worn when handling fish from different FSCAs.

3. For each cooler, count all fish, confirm species identification, and check that each fish has been tagged. The field tag will be a plastic tag with a 4-digit number that will be recorded along with all collection information on the fish collection form (FCF). It will be attached to the fish through the mouth and opercula and will remain attached to the fish until homogenization.

4. Check the field tag against the information on the FCF. If the FTL who collected the fish is present, the relevant FCFs from the FTL's notebook should be photocopied and the fish tag numbers checked against the fish in each cooler. If the FTL is not present due to scheduling logistics, the relevant pages from the notebook may be photocopied later.

5. Locate or prepare an LWF for each cooler of fish and proceed as follows:

    - A separate LWF (see Appendix B) should be used for each species collected at each FSCA.

    - A single LWF should be used for up to 25 individuals of a species at an FSCA, even if the fish were collected at different dates or times. If more than 25 fish of a species are collected from an FSCA, an additional LWF may be used.

    - Record date and time of measurement on the LWF.

6. Prepare the measuring and examination area, as follows:

    a. At the beginning of each day, and after every 20 measurements, check the calibration of the fish-weighing scale using the calibration weight.

b. Decontaminate the examination board or tray and the measuring board using a lake water rinse (rinse into a bucket or tub and discard water in the Kettle Fall Marina sewage disposal facility or fish cleaning station).

c. If necessary, decontaminate the balance pan by rinsing with lake water (this is unnecessary if the balance pan is covered with a clean piece of foil for each fish).

7. Rinse the surface of the fish by spraying with DI water to remove loose scales or other particles, dirt, or blood. Discard rinse water as described in Step 6b, above.

8. Record the field tag number on the LWF for the FSCA and species identified by the label on the cooler. This information should be cross-checked with the information on the FCF filled out by the FTL at the time of collection.

9. Measure the length of the fish. Place the fish on the measuring board with the anterior end (nose) of the fish against the zero line on the board. Measure the length of the fish at its longest point, and record the value on the LWF. Record length to the nearest millimeter.

10. Measure the weight of the fish. Tare the balance and place the fish on the balance. Make sure that any parts of the fish overhanging the balance pan are not touching the table or any other objects. Record the weight of the fish on the LWF. Record weight to the nearest gram (note that the balance used may read in 2-gram increments, in which case record to the nearest 2 grams).

11. Perform the external examination. Place the fish on the examination board or on the piece of foil that will be used to wrap the fish for storage and shipping. Fill out a fish external examination form (see Appendix B), using a separate form for each fish. A detailed explanation of each step in the examination will be available in the examination area.

12. After the examination has been performed and the length and weight recorded, wrap each fish in aluminum foil with the dull surface of the foil against the fish.

13. Fill out a secondary field tag. The secondary field tag will be used by the homogenization lab to identify the fish without unwrapping it. The tag will be an adhesive tag that will be placed on the outside of the bag and secured with clear packing tape. The minimum information on the tag will be:

    FSCA, Species, and field tag number (e.g., FSCA 1 – Walleye – 0111)

14. Wrap fish in plastic bag. Pull from the roll a length of plastic tubing about 6 inches longer than the length of the fish. Place the fish inside the bag, close the ends of the bag with cable ties, and stick the secondary field tag on the outside of the bag.

15. Place the fish in the freezer. If possible, fish of the same species and FSCA should be stored in the freezer together, either in a box or a large plastic bag. Seal the freezer with chain-of-custody tape at the end of each day or if leaving the vicinity of the trailer.

16. Place two photocopies of the FCFs and LWFs in files in the onshore office trailer. One copy will remain in the file onshore for the duration of the project, and the second copy will be transported offsite for storage.

17. Add fish tag numbers to the electronic file. Forms II Lite will be used to generate chain-of-custody forms. Input all data into the electronic file (at the instruction of the SPC) daily or as often as practical.

Shipping

Fish will be prepared for shipping to the offsite processing laboratory by using the following procedures.

1. Sturdy plastic coolers will be used as shipping containers. Holes for ventilation will have been drilled in the lid of the cooler. Enough fish will be placed in each cooler to occupy the majority of the cooler volume, and the remaining space in the cooler will be filled with dry ice and insulating material. A completed chain-of custody form and copies of the field record forms for the samples will be included in each cooler. Both forms are described in QAPP Section 2.6.2.
2. When possible, fish in the coolers will be grouped according to species and collection site to facilitate organization and sample management upon receipt at the offsite processing laboratory.
3. After each cooler is packed with fish samples and dry ice, it will be secured at both ends with nylon strapping tape and the following items will be attached:
    - Address label for processing laboratory
    - Two custody seals
    - Overnight shipping airbill
    - Perishable goods label
    - Class 9 Dangerous Goods Label (required by U.S. Department of Transportation (DOT) for coolers containing dry ice that will be shipped by air)
4. When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler).

Corvallis ASL Standard Operating Procedure

STANDARD OPERATING PROCEDURE FOR FISH HOMOGENIZATION USING ROBOT COUPE BLIXER®

APPROVED:

Ginger Collins

8/26/05

QA Officer — Date

8/26/05

Laboratory Director — Date

I have read and understood the following Standard Operating Procedure (SOP) and agree to follow the SOP as written. Any exceptions to the SOP will be recorded in the appropriate logbook or benchsheet and changes will be noted in the case narrative of the report to the client.

STANDARD OPERATING PROCEDURE FOR FISH HOMOGENIZATION USING ROBOT COUPE BLIXER®

1.0 SCOPE AND APPLICATION

This method describes the process for homogenizing fish tissue using the Robot Coupe Blixer® commercial food processor.

2.0 OVERVIEW OF THE ANALYTICAL PROCESS

Frozen or partially frozen fish is sectioned into pieces. The pieces are reduced to a consistency of a course powder using the Robot Coupe Blixer® commercial food processor. The client must provide the laboratory with sample homogenization requirements in writing prior to the arrival of the samples; otherwise, all samples will be processed as whole body homogenizations.

3.0 TARGET ANALYTES, REPORTING LIMITS, AND DETECTION LIMITS

This method is to be used for the preparation of tissue samples for analysis of trace semivolatiles, pesticides, PCBs, and metals.

4.0 INTERFERENCES

Contaminants in solvents, cutting utensils, and homogenizing hardware may cause method interferences. Paper towels may contain metals.

5.0 SAFETY, WASTE MINIMIZATION, AND POLLUTION PREVENTION

5.1 Appropriate protective equipment and clothing must be used when handling methanol and 1+4 nitric acid. Safety glasses, gloves and lab coats are a minimum requirement.

5.2 Liquid nitrogen or liquid argon is extremely cold (~185 °C) and will cause burns immediately upon contact with skin. Care should be taken when handling or storing any cryogenic liquid. Cryogenic liquids should never be stored in a gas tight container, even temporarily, because extreme pressure can build very rapidly.

5.3 Laboratory wastes shall be separated and properly disposed of, complying with all federal, state, and local regulations. The wastes include collected solvent rinses, expired sample extracts, and disposable labware (or other items as applicable) used in the preparation of the samples. These wastes shall be handled according to CVO SOP HAZ01, Waste Disposal.

5.4 Analysts are encouraged to reduce the amount of solvent or disposable labware waste whenever possible. More information on this topic can be found in "Less is Better: Laboratory Chemical Management Waste Reduction" located on the American Chemical Society website at http://membership.acs.org/c/ccs/pub_9.htm.

5.5 Records to be destroyed will be recycled whenever possible.

6.0 SAMPLE COLLECTION, STORAGE, HOLDING TIMES AND PRESERVATION

6.1 Whole fish should be collected in aluminum foil or foil lined bag and shipped on wet ice from the field to the laboratory if next-day delivery is assured. The temperature of the fish should be 4 °C upon arrival at the laboratory. If the fish cannot be shipped right away, samples should be stored frozen at –20 °C and shipped frozen on wet ice or dry ice.

6.2 No holding times have been established for tissue samples. PSEP protocols recommend storage of tissue samples for no longer than 1 year at –20 °C.

7.0 APPARATUS AND MATERIALS

7.1 Robot Coupe Blixer® 6
7.2 Glass cutting board
7.3 Stainless steel saw and blade
7.4 Stainless steel spatula
7.5 Stainless steel utility knife
7.6 Electric knife with stainless steel blades
7.7 Scalpel with replaceable stainless steel blades
7.8 Stainless steel fillet knife
7.9 Forceps
7.10 Teflon coated probe
7.11 Tweezers
7.12 Precleaned glass containers

8.0 STANDARDS, GASES, AND REAGENTS

8.1 Rinse solvent - methanol, pesticide quality or equivalent
8.2 Type II Millipore water
8.3 Phosphate-free detergent
8.4 1+4 Nitric acid prepared by adding one part concentrated nitric acid to four parts type II Millipore water
8.5 Liquid nitrogen or liquid argon

9.0 QA/QC

An estimate of the measurement uncertainty is available upon request. The measurement uncertainty will be estimated following SOP30. The largest possible source of uncertainty for this analytical procedure is incomplete homogenization of the sample.

10.0 PROCEDURE

10.1 Fish Tissue Homogenization

10.1.1 Each day before extraction, check and record the balance calibration using the procedure described by ASL SOP15, The Use of Analytical Balances.

10.1.2 Rinse out 7-quart stainless steel bowl, S-blade unit, cutting board, spatulas, and cutting utensils three times with 1+4 nitric acid followed by three rinses with pesticide grade methanol and finally with three rinses of Type II Millipore water. The S-blade unit does not require disassembly.

10.1.3 Record in the Fish Homogenization Logbook the lab ID, client ID, mass of fish before grinding, start time, analyst initials, and any additional information about the homogenization procedure. An example fish homogenization log is shown in Figure 1.

10.1.4 If the fish is to be filleted, the otolith removed, or sex of fish determined, the fish will be allowed to thaw at room temperature; otherwise, proceed to step 10.1.8.

10.1.5 If the otolith is removed, store the otolith in the proper container and preservative. The container and preservative shall be specified by the client. Label the container with sample ID, date, time, and species of fish.

10.1.6 If the sex of the fish is to be determined, record the the sex of the fish in the Fish Homogenization Logbook.

10.1.7 Once the otolith is removed and/or sex of fish determined, skip to step 10.1.9. If the fish will not be homogenized right away, wrap the fish in the original aluminum foil and return to the freezer.

10.1.8 If the whole fish is to be homogenized, allow the fish to thaw for 10 minutes to allow ease of cutting.

10.1.9 For whole fish homogenization, place the fish on a glass cutting board and cut the fish into small pieces using a stainless steel saw, electric knife with stainless steel blade, or stainless steel utility knife.

10.1.10 If the fillet and offal are to be grounded separately, first fillet the fish and separatethe fillet from the offal. Treat the fillet and offal as two separate samples for processing. DO NOT COMBINE.

10.1.11 Place a single section of fish into the Robot Coupe Blixer® stainless steel bowl. Pulse chop the fish piece by toggling the on and off switch.

10.1.12 Once the size of the fish section has been reduced, introduce an additional section of fish into the stainless steel bowl. Repeat the pulse chopping.

10.1.13 Repeat steps 10.1.11 and 10.1.12 until the entire fish has been processed or the stainless steel bowl is half full.

10.1.14 If the size of fish is large enough that the stainless steel bowl exceeds half capacity, empty the contents of the bowl into a pre-cleaned glass container. Repeat steps 10.1.9 through 10.1.13 for the remainder of the unprocessed fish. When the entire fish has been processed, combine the contents of the entire fish into the stainless steel bowl.

10.1.15 Pour 10 to 20 milliliters of liquid nitrogen onto the chopped fish (in the stainless steel bowl) and continue chopping at slow speed to further reduce the tissue size and homogenize the sample.

10.1.16 Once chopping is complete, the tissue should be the consistency of a coarse powder.

10.1.17 Empty the contents of the stainless steel bowl into pre-cleaned glass jars, label, and place in the freezer.

10.1.18 If the next fish to be homogenized is for the same composite, rinse out the 7-quart stainless steel bowl, S-blade unit, cutting board, spatulas, and cutting utensils three times with 1+4 nitric acid followed by three rinses with pesticide grade methanol and finally with three rinses of Type II Millipore water. The S-blade unit does not require disassembly.

10.1.19 If the next fish to be homogenized is for a different composite or all of the samples have been homogenized, full decontamination is required. Disassemble the S-blade unit. Wash all pieces of the S-blade unit, the 7-quart stainless steel bowl, cutting board, spatulas, and cutting utensils in the following order:

- 10.1.19.1 Scrub with warm water and phosphate free detergent
- 10.1.19.2 Rinse with copious amounts of cold water
- 10.1.19.3 Rinse with copious amounts of DI water
- 10.1.19.4 Rinse three times with 1+4 nitric acid
- 10.1.19.5 Rinse three times with pesticide grade methanol
- 10.1.19.6 Rinse three times with Type II Millipore water
- 10.1.19.7 Allow to drip dry; do not use paper towels because paper towels may contain low levels of metals
- 10.1.19.8 Reassemble the S-blade unit and repeat steps 10.1.3 through 10.1.19

10.1.20 If the equipment is being cleaned for overnight storage or storage for a longer time, the methanol and 1+4 nitric rinse is not necessary. Dry equipment with a paper towel to prevent oxidation of metal parts.

11.0 DATA REDUCTION

Not applicable.

12.0 DOCUMENTATION

The fish preparation logbook is kept in the extraction laboratory. A completed logbook is kept in the laboratory for a minimum of 1 year. After a minimum of 1 year, the logs are moved to our offsite record center; see SOP17, Data Storage.

13.0 REFERENCES

Puget Sound Estuary Program (PSEP). 1997. *Recommended Guidelines for Measuring Organic Compounds in Puget Sound Water, Sediment and Tissue Samples.*

14.0 DEFINITIONS

14.1 ASL – Applied Sciences Laboratory
14.2 CVO – Corvallis, OR
14.3 DI – Deionized Water
14.4 PCB – polychlorinated biphenyl
14.5 PSEP – Puget Sound Estuary Program
14.6 QA/QC – Quality Assurance/Quality Control
14.7 QA – Quality Assurance
14.8 QC – Quality Control
14.9 SOP – Standard Operating Procedure

Figure 1

FISH HOMOGENIZATION LOG					
Lab ID	**Client ID**	**Mass Before Grounding (g)**	**Start Time**	**Sex of Fish (M/F)**	**Analyst Initial**

Appendix D
Statistical Assessment

APPENDIX D

Statistical Assessment Technical Memorandum

Recommended Design and Analysis for the Upper Columbia River Fish Tissue Sampling Program

Prepared for:
Frank Dillon
CH2M Hill
1100 112th Avenue NE, Suite 400
Bellevue, Washington 98004-4505

Prepared by:
John R. Skalski
Columbia Basin Research
School of Aquatic and Fishery Sciences
University of Washington
1325 Fourth Avenue, Suite 1820
Seattle, Washington 98101

16 May 2005

SEA/052420019

1.0 Introduction

The fish tissue sampling program for the Upper Columbia River (UCR) has as its basic goal to collect information on contamination levels in resident fish for wildlife and human risk assessment. Five fish species will be sampled to obtain data on heavy metal and organic pollutants. The data collection will occur at six sites within a 150-mile stretch of river between Grand Coulee Dam and the international border with Canada.

Concurrent with the goal to collect tissue contaminant concentrations for risk assessment, there are ancillary objectives in the field sampling program. These include:

1. Characterize the spatial patterns of contaminants.
2. Establish baseline contaminant levels for comparison with future surveys.
3. Correlate tissue concentrations with contaminant concentrations in sediment.
4. Compare contaminant levels between fish species.
5. Compare contaminant levels between river reaches.
6. Characterize the variation in contaminant concentrations between individual fish of a species.

This report summarizes the main statistical elements of the proposed sampling scheme as well as the anticipated levels of sampling precision and statistical power to detect differences in mean contaminant levels.

2.0 Overview of Sampling Scheme

A total of 180 composite samples of fish will be collected over 6 locations (Table 1). Each composite be composed of tissue samples from 5 individual fish. This allocation of effort was devised to satisfy several concurrent goals as described below.

2.1 Species Selection

Tissue samples will be analyzed from 5 different fish species selected for their prevalence in the system, their recreational and consumptive use by local populations, and their different life strategies. Walleye, rainbow trout, and white fish represent pelagic species, while sucker and burbot represent demersal species, which may come in contact with contaminants differently.

Table 1. Proposed number of sample composites to be collected by fish species, tissue type (i.e., WF for whole fish, F for fillet), and location.

Reach	Area	Walleye (WF)	Walleye (F)	Rainbow trout (WF)	Rainbow trout (F)	Whitefish (WF)	Sucker (WF)	Burbot (WF)
Upper	1	5	5	5	5	5	5	5
	2							
	3			5	5	5	5	5
	4							
Middle	5	5	5	5	5	5	5	5
	6							
	7			5	5	5	5	5
	8							
	9							
Lower	10			5	5	5	5	5
	11	5	5	5	5	5	5	5

The objective of sampling as wide a range of fish species as possible will therefore be fulfilled by the design in Table 1.

Whole body concentrations will be determined from 30 composite samples of each of the five species. These 30 samples per species can be used to compare mean concentrations between species.

2.2 Whole Fish Versus Fillet Concentrations

For walleye and rainbow trout, contaminant concentrations will be determine for both whole fish and fillet tissues. A total of 15 composites for whole fish and fillet tissue concentrations will be processed per species across the region (Table 1). The samples of the fillet tissues and carcass remains (i.e., offal) will be placed in paired composite samples for analysis. The result will be 15 paired samples that will permit calculation of the correlation between contaminant concentrations in fillet and carcass remains. Whole fish concentrations will be reconstructed from the separate estimates of fillet and offal tissue concentrations.

2.3 Regional Characterization and Comparison

The Upper Columbia River study area has been stratified into three reaches: Upper (sample areas 1-4), Middle (sample areas 5-9), and Lower (sample areas 10-11). Composite samples will be collected at areas 1, 3, 5, 7, 10, and 11 across the breadth of the study area (Table 1). The six locations will provide information on spatial trends in contaminant concentrations within the Upper Columbia River study area. Within each reach, 10 composite samples per fish species will be analyzed. The 10 replicate composite samples within a reach will be used to compare mean contaminant concentrations between areas (i.e., Upper, Middle, or Lower).

2.4 Correlation Between Tissue and Sediment Concentrations

Sediment, as well as fish tissue samples, will be collected at areas 1, 3, 5, 7, and 11 (Table 1). These five areas will permit examination of the correlation between concentrations of contaminants observed in fish tissues and sediment. Sampling fish tissues at five of the six

primary sediment sampling locations (i.e., 1, 3, 5, 7, 9, 11) was a deliberate step to enhance the correlation analysis.

2.5 Variability in Individual Fish Concentrations

Within a sampling area, fish will be randomly assigned to the replicate composite samples in order to estimate the between-fish variability in contaminant concentrations. When fish are randomly selected within a locale for compositing, the expected value of the observed concentration (C) is the mean (μ) of the individual fish concentrations, i.e.,

$$E(C) = \mu .$$

If several composites are created randomly and analyzed, their observed variability $\left(s_C^2\right)$ has the expected value

$$E\left(s_C^2\right) = \frac{\sigma^2}{k},$$

where

σ^2 = variance in individual fish concentrations,

k = number of fish forming the composite.

Hence, an estimator of σ^2, the fish-to-fish variability, is

$$\hat{\sigma}^2 = k \cdot s_C^2,$$

where

$$s_C^2 = \frac{\sum_{i=1}^{n}\left(C_i - \bar{C}\right)^2}{(n-1)},$$

and where

$$\bar{C} = \frac{\sum_{i=1}^{n} C_i}{n},$$

n = number of composite samples formed at a locale.

Hence, while individual fish tissues will not be analyzed, careful compositing will preserve some of the information on between-fish variability in contaminant concentrations (i.e., σ^2). What is unresolved is information on minimum and maximum concentrations. A considerable increase in study costs would be necessary to obtain this additional information.

3.0 Recommended Analyses

3.1 Reach and Species Comparisons

The sample sizes in Table 1 provide a balanced design to readily compare the three river reaches (i.e., upper, middle, and lower) and the five fish species (walleye, rainbow trout, lake whitefish, sucker, and burbot) using a two-way ANOVA of the form

Sources	DF
TotalCor	149
Reaches	2
Species	4
Reach x species	8
Error	135

F-tests can be used to test the main effects of species and reaches as well as their interactions. Separate estimates of species by reach can be calculated with 9 degrees of freedom for nonplanned comparisons.

3.2 Estimating Mean Concentrations

Within a locale or river reach, mean tissue concentrations will be based on the arithmetic mean of composite sample values, where

$$\hat{\bar{C}} = \frac{\sum_{i=1}^{n} C_i}{n},$$

with associated sampling variance

$$\text{Var}\left(\hat{\bar{C}}\right) = \frac{s_{C_i}^2}{n},$$

where

$$s_{C_i}^2 = \frac{\sum_{i=1}^{n}\left(C_i - \hat{\bar{C}}\right)^2}{(n-1)}.$$

4.0 Precision and Sample Size Calculations

Sampling precision will be defined as

$$P\left(\left|\frac{\hat{\bar{C}} - \bar{C}}{\bar{C}}\right| < \varepsilon\right) = 1 - \alpha,$$

where ε is the relative error in estimation, $(1-\alpha)$ 100% of the time. For example, the desire for the error in estimation to be less than 20%, 90% of the time, would be expressed as

$$P\left(\left|\frac{\hat{\bar{C}} - \bar{C}}{\bar{C}}\right| < 0.20\right) = 0.90,$$

where $\varepsilon = 0.20$ and $\alpha = 0.10$.

Assuming $\frac{\hat{\bar{C}} - \bar{C}}{\bar{C}}$ normally distributed, the required sample size is

$$kn = \frac{\text{CV}^2 Z^2_{1-\frac{\alpha}{2}}}{\varepsilon^2}, \qquad (1)$$

where

n = number of composite samples,

k = number of tissue samples per composite,

CV = coefficient of variation in tissue concentrations between fish $\left(\text{i.e., } \frac{\sigma}{\mu}\right)$,

$Z_{1-\frac{\alpha}{2}}$ = Z-statistic (e.g., $\alpha = 0.05 \rightarrow Z = 1.96$ or $\alpha = 0.10 \rightarrow Z = 1.645$).

Examination of Eq. (1) indicates that the required sample size depends on the CV in fish concentrations. Historical data from the UCR were used to characterize the anticipated CV (Table 2) . Coefficients of variation were calculated by locale for two heavy metals (arsenic, mercury) and two organics (TCD_ and HXCD complexes) and summarized by their range, median, and mean. Mean CV values ranged from 0.45-0.75; ,median values were somewhat lower (i.e., 0.36-0.69).

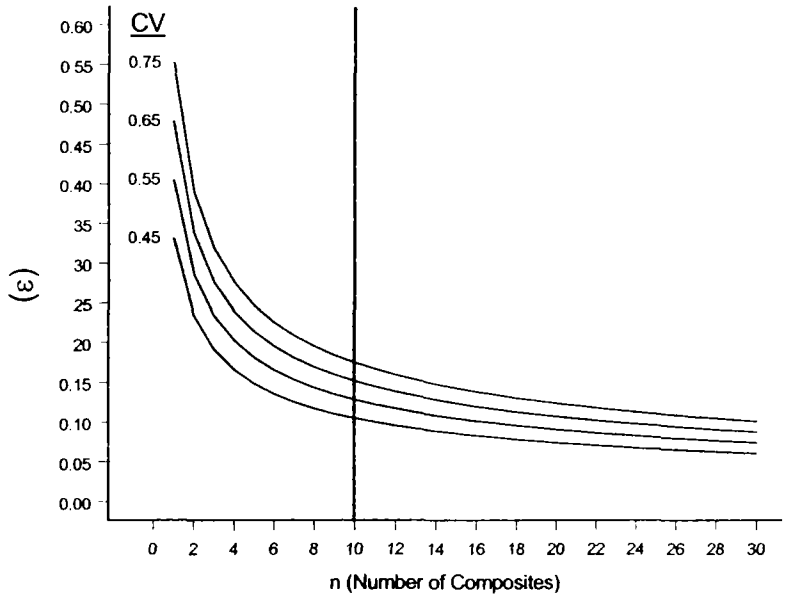
Table 2. Coefficients of variation for four contaminants based on replicate fish within a locale. Values based on the 1986-98 surveys of the UCR.

Component	Range of CV	Median CV	$\overline{CV}$
Arsenic	0.19-1.23	0.69	0.65
Mercury	0.22-0.76	0.36	0.45
TCD_	0.26-2.05	0.50	0.75
HXCD	0.47-1.38	0.69	0.75

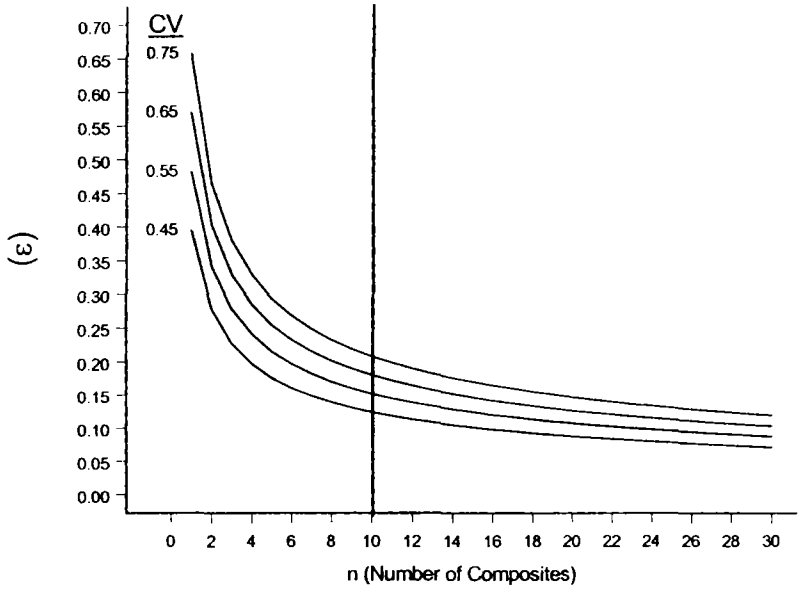
Figure 1 provides precision curves versus sample size (i.e., CV versus n) for various values of CV (i.e., 0.45, 0.55, 0.65, 0.75) and $1-\alpha = 0.90, 0.95$. The recommended sample sizes (n) are the number of composites at a locale or reach assuming $k = 5$ fish per composite. Examination of Figure 1a indicates, for example, that 10 composites within a reach will provide a precision of $\varepsilon = 0.011$-0.17, 90% of the time for CVs = 0.45-0.75. At individual sites with 5 replicate composites, the anticipated precision is in the range of $\varepsilon = 0.15$-0.27 for CVs = 0.45-0.75.

Figure 1. Precision curves of relative error (ε) versus number of composites (n) for various values of CV when (a) $1-\alpha = 0.90$ and (b) $1-\alpha = 0.95$. Calculations based on composites of $k = 5$ fish each.

a. $1-\alpha = 0.90$



b. $1-\alpha = 0.95$



5.0 Statistical Power and Sample Size Calculations

Statistical tests may be used to compare mean contaminant concentrations between geographic areas or fish species. The simplest comparison is a two-sample test of equal means, i.e.,

$$H_o: \ \mu_1 = \mu_2$$
versus
$$H_o: \ \mu_1 \neq \mu_2.$$

The statistical power $(1-\beta)$ to reject the null hypotheses (H_o) when H_a is true at a significant level of α, two-tailed, can be calculated as a function of sample size. The power of the test will depend on how large a difference (Δ) in the mean concentration exists. Three different effect sizes were considered; 25%, 50%, and 100% increases in concentrations (or equivalently, 20%, 33%, and 50% decreases in concentrations).

Statistical power curves were constructed when Δ = 0.25, 0.50, or 1.0 as a function of the number of composite samples per sample mean when fish concentrations had a CV = 0.45, 0.55, 0.65, or 0.75 (Figure 2). It is assumed each composite is based on pooling the tissues of 5 fish. For the sample size of 10 composites per mean, there is a statistical power range of 0.99-1.00 to detect a 100% increase (50% decrease) in concentration when CVs = 0.45-0.75. For a 25% increase (20% decrease), the statistical power has a range of 0.28-0.66 with 10 composites per treatment.

Figure 2. Power curves to detect a 25%, 50%, or 100% increase in contaminant concentrations between means at $\alpha = 0.05$, two-tailed, when the coefficient of variation for between-fish variability is CV = 0.45, 0.55, 0.65, or 0.75.